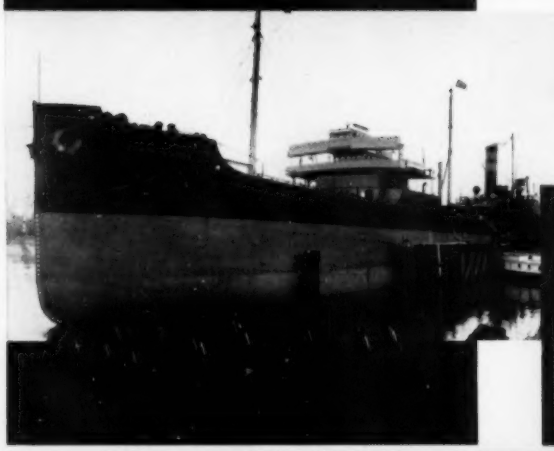
World Petroleum

MAY, 1952

CANADIAN REVIEW NUMBER • ONE DOLLAR PER COPY

WARREN'S Stabilized



Any Way You Want it

To aid the refiner in meeting the increasing demand for more and better motor fuel, all methods are available to transport WARREN'S STABILIZED Natural Gasoline when and where you need it. And you can depend upon STABILIZED Natural Gasoline for the essential elements of high octane rating, greater volatility, low front end. You can be ready for any demand in any season when you rely upon WARREN.

We manufacture special high octane blending agents which command higher prices but will help solve your octane problems.

NATURAL GASOLINE
Propane
Iso-Butane
Butane
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30 YEARS' SERVICE

WARREN PETROLEUM CORPORATION

Producers, Manufacturers, Exporters and Marketers

Export Terminals: Corpus Christi, Port Arthur, Baytown, Texas City, and Norsworthy, Houston, Texas.

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Crude Oil, Natural Gasoline and Liquefied Petroleum Products

HORTON TANKS

at New Products

Pipe Line Terminal

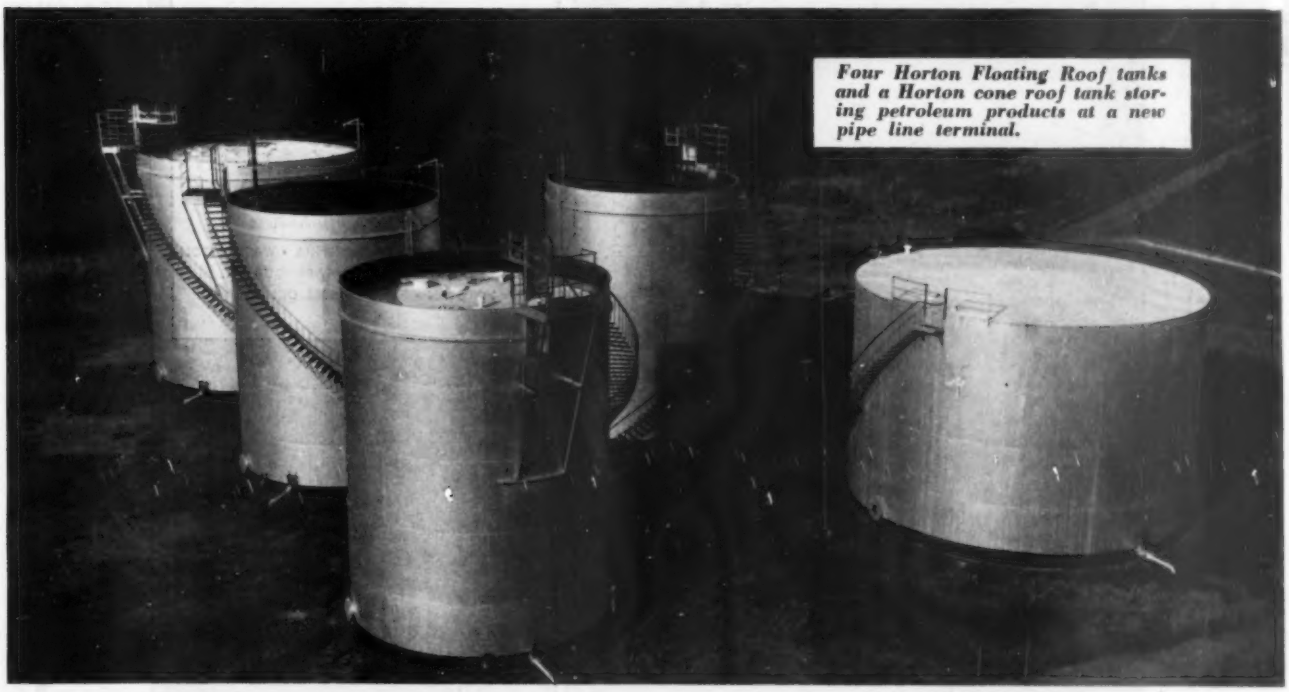
THESE Horton Floating Roof tanks and Horton cone roof tanks are used to store petroleum products at a new pipe line terminal.

Operators of pipe line terminals and pumping stations throughout the world depend on tanks equipped with Horton Floating Roofs to prevent filling losses and reduce breathing losses of volatile hydrocarbons. They know that Horton Floating Roofs ride directly on the liquid in the tank thus eliminating the vapor space which is responsible for evaporation losses. They also know that the improved Horton Seal prevents evaporation from taking place between the deck of the Horton Floating Roof and the shell of the tank itself.

Horton cone roof storage tanks provide excellent storage facilities for the less volatile and non-corrosive hydrocarbons. Butt welded construction assures longer life and simple, inexpensive maintenance.

Whether you operate a pipe line terminal, refinery, or a gas processing plant, investigate the advantages of Horton tanks when you require new storage facilities. Horton tanks can be built to fit practically every requirement.

Write our nearest office for complete details. There is no obligation on your part.



Four Horton Floating Roof tanks and a Horton cone roof tank storing petroleum products at a new pipe line terminal.

CHICAGO BRIDGE & IRON COMPANY

Chicago • Houston • Tulsa • San Francisco • Birmingham • Atlanta • Cleveland • Philadelphia • Los Angeles • Boston • Seattle • Detroit • Washington
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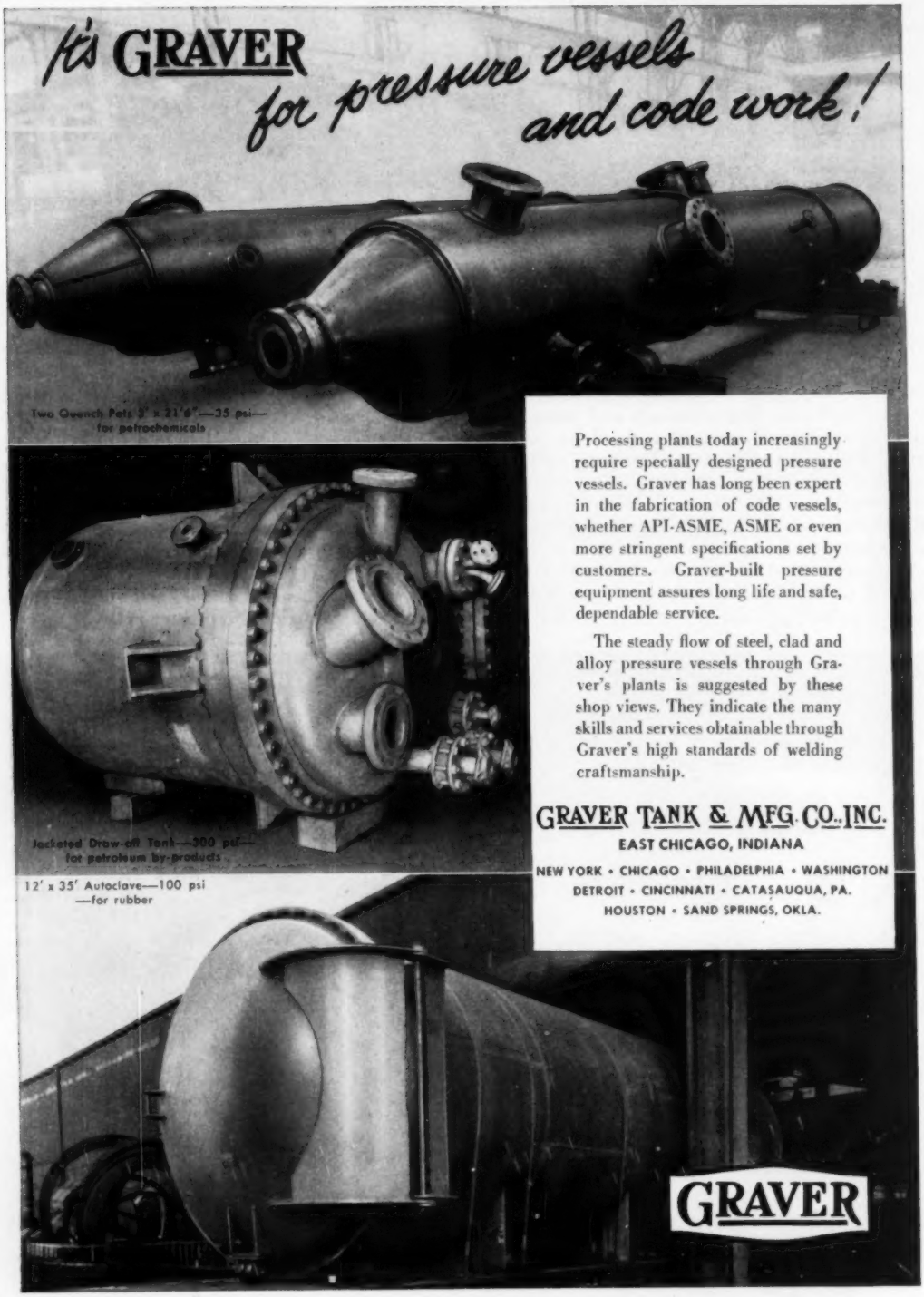
W. P. Bryant, Edifico Abreu 402, Havana, Cuba
Sociedade Chibridge de Construcoes Ltda., Av. Franklin Roosevelt, 194-S/704 C, Rio de Janeiro, Brazil



Processing plants today increasingly require specially designed pressure vessels. Graver has long been expert in the fabrication of code vessels, whether API-ASME, ASME or even more stringent specifications set by customers. Graver-built pressure equipment assures long life and safe, dependable service.

The steady flow of steel, clad and alloy pressure vessels through Graver's plants is suggested by these shop views. They indicate the many skills and services obtainable through Graver's high standards of welding craftsmanship.

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

NEW YORK • CHICAGO • PHILADELPHIA • WASHINGTON
DETROIT • CINCINNATI • CATASAUQUA, PA.
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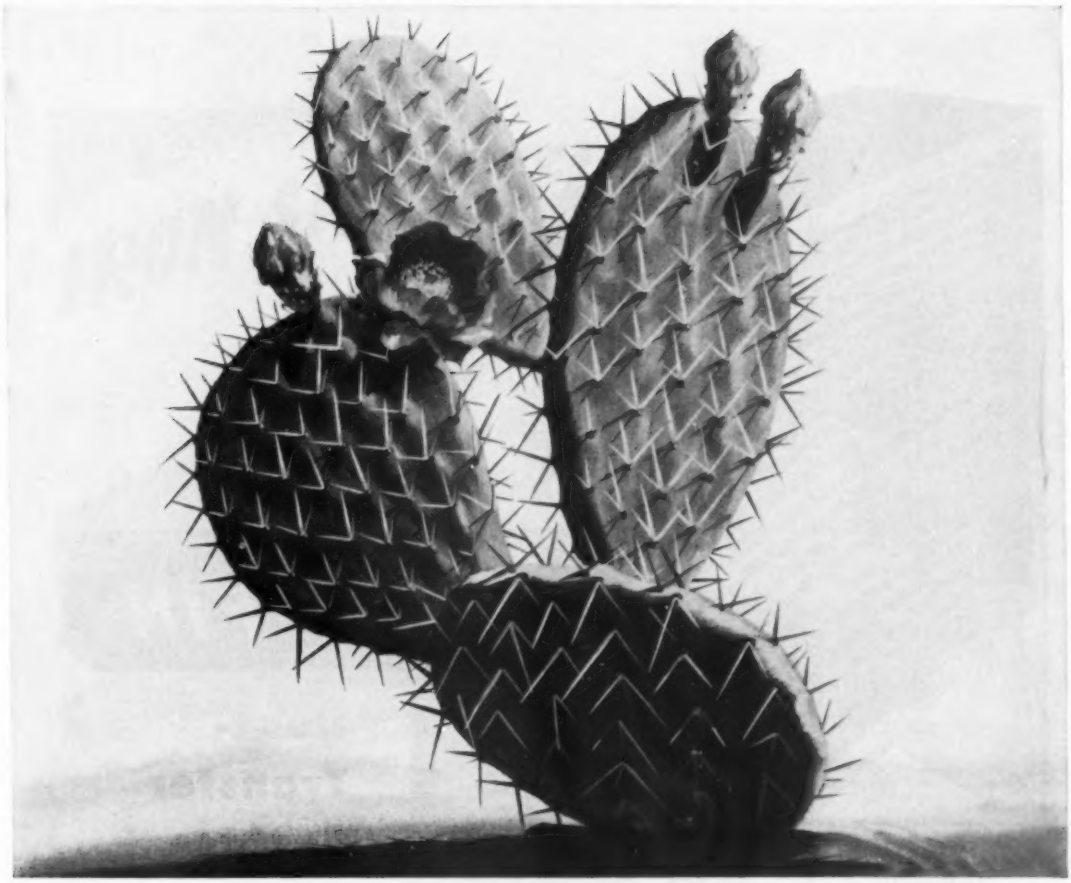
WORLD PETROLEUM for May, 1952. Vol. 23, No. 5. May, 1952. WORLD PETROLEUM is published monthly by Mona Palmer, Trustee under the will of Russell Palmer, 2 West 45th St., New York 36, N. Y. Acceptance at East Stroudsburg, Pa., under Section 34.64 P. L. & R. Authorized. Subscription rate: $5.00 per year, single copies $1.00. Copyright, 1952 by Mona Palmer, Trustee.



What is the most important point about our new Texas plant?

It probably would be more usual to announce the opening of Ethyl's new Texas plant by showing a large air view of the entire layout. However, this close-up of another kind of Texas plant better illustrates our point.

You see, the plant in the picture above is completely self-sustaining. Just give it sunlight, air, a little water, and a place to grow. It depends only upon raw materials to make the complex chemicals it needs to stay in business. In other words, it is a *completely integrated* plant . . . just like the new Ethyl plant at Houston, Texas.

Give Ethyl's new Texas plant the raw materials—such as pig lead, salt, petroleum gases, electricity—and it can make all the chemical ingredients needed in "Ethyl" antiknock compound. In this way it is like Ethyl's plant at Baton Rouge. Each is completely integrated—and is independent of the other.

We think this integration is an extremely important point to refiners. Today refiners are faced with the challenge of supplying great quantities of high-quality gasoline to meet the ever-increasing demands of American transportation. To perform this service, they need an uninterrupted supply of antiknock compound—which an *integrated* plant is best able to give.

With the construction of Ethyl's new Texas plant, such a reliable source of antiknock compound is now assured. The new plant is engineered for highest efficiency. Raw materials are available nearby. Electric power supplies are ample. Six railroads out of Houston give Ethyl wide choice in routing antiknock compounds to Ethyl customers throughout the country. And, perhaps most important, this new plant has expanded facilities to a point where "Ethyl" antiknock compound manufacturing capacity is now more than ample to meet demand in the foreseeable future.

ETHYL CORPORATION . . . New York 17, New York

AEROFIN

Heat-Transfer Surface

Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

● High Efficiency

● Long Service Life

● Low Maintenance Costs

You are assured of high efficiency in heating or cooling—long service life—low maintenance and service costs, when you specify Aerofin extended-surface heat exchangers.

The reason is obvious: Aerofin makes heat exchangers *exclusively*—offers you the results of unequalled experience, unequalled production facilities, unequalled materials testing and design research—and the guidance of a complete, highly skilled engineering staff, at the plant and in the field.

For the most practical solution to your heat-exchange problem, ASK THE AEROFIN MAN.

AEROFIN CORPORATION 410 South Geddes St. SYRACUSE 1, N. Y.

Gold Depository in Fort Knox, Kentucky

. . . more important than gold!

The most important metal today is not the tons of gold buried at Ft. Knox!

Far more important are the millions of tons of iron and steel scrap so desperately needed to make new steel. All scrap, actual and potential, needs to be gathered up and channeled to the steel producing plants-NOW, today, tomorrow and tomorrow. So long as the steel industry is called upon to produce two million and more tons of ingot steel per week, it must have one million and more tons of scrap each week.

Steel producers are getting the iron ore, limestone and coal they need. But the scrap situation is critical and will continue to be so until inventories are built up substantially.

As a user of steel--as one interested in seeing that America's rearmament program is not too little and too late--you can do your part to see that your community and your business keep scrap moving toward the mills.

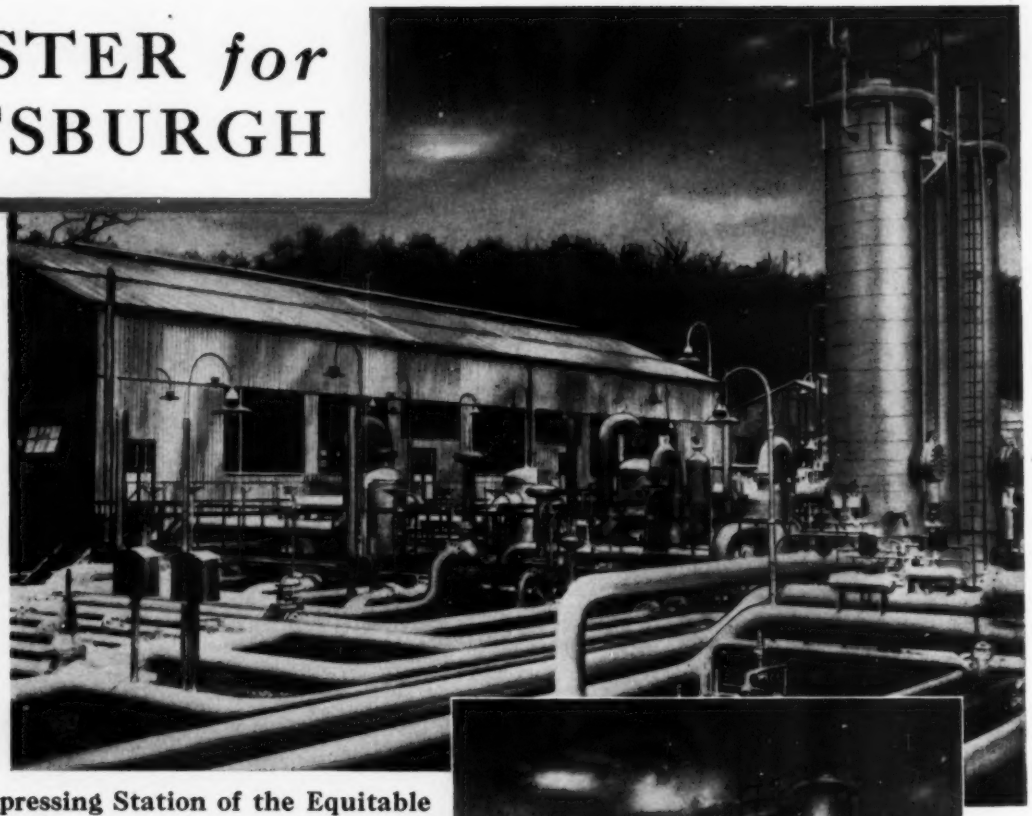
YOUR SCRAP IS NEEDED — YOUNGSTOWN

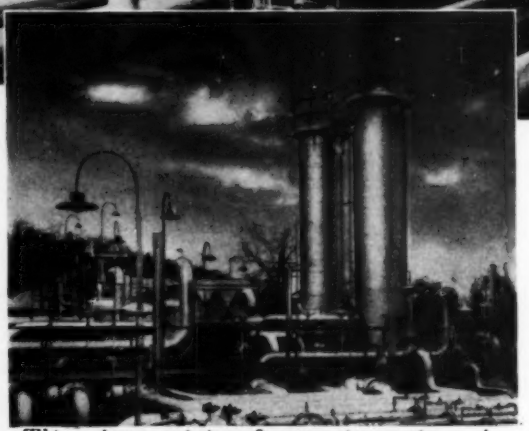
The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment

BOOSTER *for* PITTSBURGH





The Pratt Compressing Station of the Equitable Gas Company will increase the flow of natural gas to the Pittsburgh area during periods of high demand.

Pressure is boosted; gas from a local field is compressed and delivered to the system; and gas compressed and stored underground during low periods is released as needed.

Stone & Webster Engineering Corporation was retained for the design, and supervision of construction of the Pratt Station.

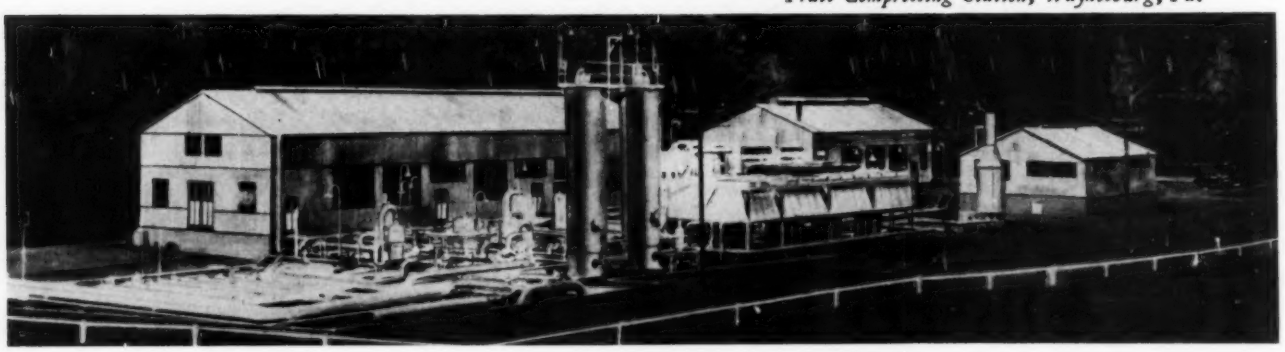
This project, consisting of compressing station and a dehydration unit, has a capacity of 52 million standard cubic feet per day.

STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

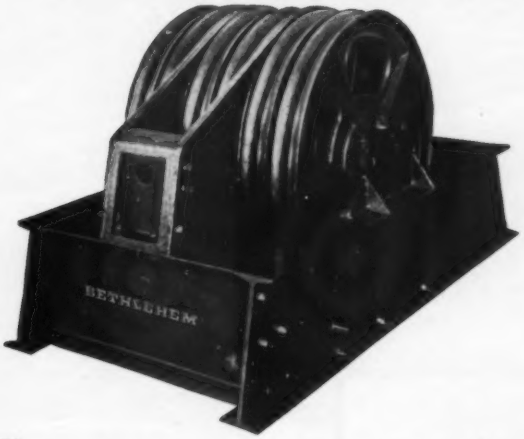
AFFILIATED WITH E. B. BADGER & SONS (GREAT BRITAIN) LTD.

Pratt Compressing Station, Waynesburg, Pa.



For Truly Balanced Performance

EQUIP YOUR RIG WITH ALL THESE BETHLEHEM COMPONENTS



For smoothest, fastest, most trouble-free operation, all drilling-rig components should work in complete harmony. Bethlehem makes this possible with matched sets of crown and traveling blocks, swivels, and rotary tables. From Bethlehem's wide assortment you can select the combination that meets your needs exactly.

CROWN BLOCKS—4 sizes. Capacities, 80 to 350 tons.

TRAVELING BLOCKS—4 sizes. Capacities, 80 to 350 tons.

SWIVELS—4 sizes. Capacities, 60 to 300 tons.

ROTARIES—2 sizes, 17½-in. and 21-in. Capacities to 18,000 ft. with 4½-in. drill pipe. Also available as unitized outfits with Hydrodrive and independent prime mover.

Bethlehem Steel Export Corporation
25 Broadway, New York 4, N. Y., U.S.A.
Cable Address: "BETHLEHEM, NEWYORK"

BETHLEHEM STEEL

Note: Bethlehem manufactures a full line of slush pumps and drawworks for shallow, medium, and deep drilling; and, for production work, pumping units in a wide range of sizes and types. Write for full information.

You need no road with 4-wheel drive

THE 4-WHEEL-DRIVE
UNIVERSAL 'Jeep'®

THE 4-WHEEL-DRIVE
WILLYS
STATION WAGON

THE 4-WHEEL-DRIVE WILLYS TRUCK

"Impassable" means nothing to these 4-wheel-drive Willys vehicles. They are built for rugged off-the-road service, with extra traction and pulling power for getting through where conventional vehicles cannot operate. They do the toughest job without faltering. You can count on them for uninterrupted transportation of personnel, supplies and equipment to all parts of the oil field.

WILLYS-OVERLAND EXPORT CORPORATION
Toledo 1, Ohio, U.S.A.

TWO GREAT "FIRSTS" for Canadian Oil!

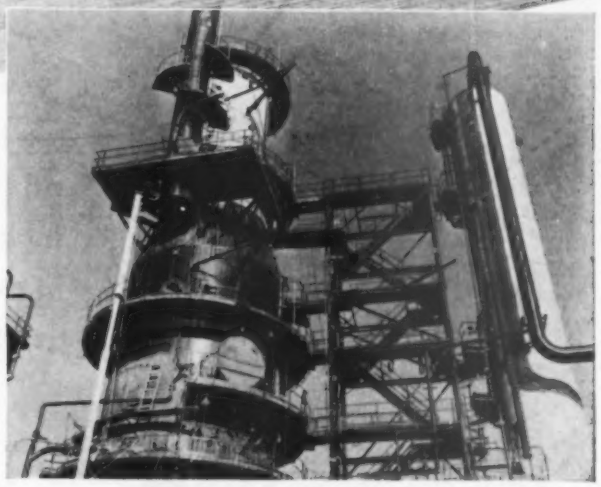
Catalytic platforming unit now nearing completion

FIRST catalytic platforming unit in Canada

FIRST fluid catalytic cracking unit in Ontario

...both at Canadian Oil's new $22,000,000 Sarnia refinery.

With a 44-year background of service to the motoring public and to industry, Canadian Oil Companies, Limited, is now bringing "on stream" Canada's newest major refinery. This refinery, the most modern on the continent in design and in refining techniques, is located at Sarnia, Ontario, across the St. Clair River from Port Huron, Michigan. Designed to use Alberta crude, it will have an operating capacity of 20,000 barrels per day!



Orthoflow converter of catalytic cracking unit

CANADIAN OIL COMPANIES, LIMITED

refiners and marketers of

WHITE ROSE

PETROLEUM PRODUCTS

Royal Sulphuric Acid Works

Ketjen Founded 1835

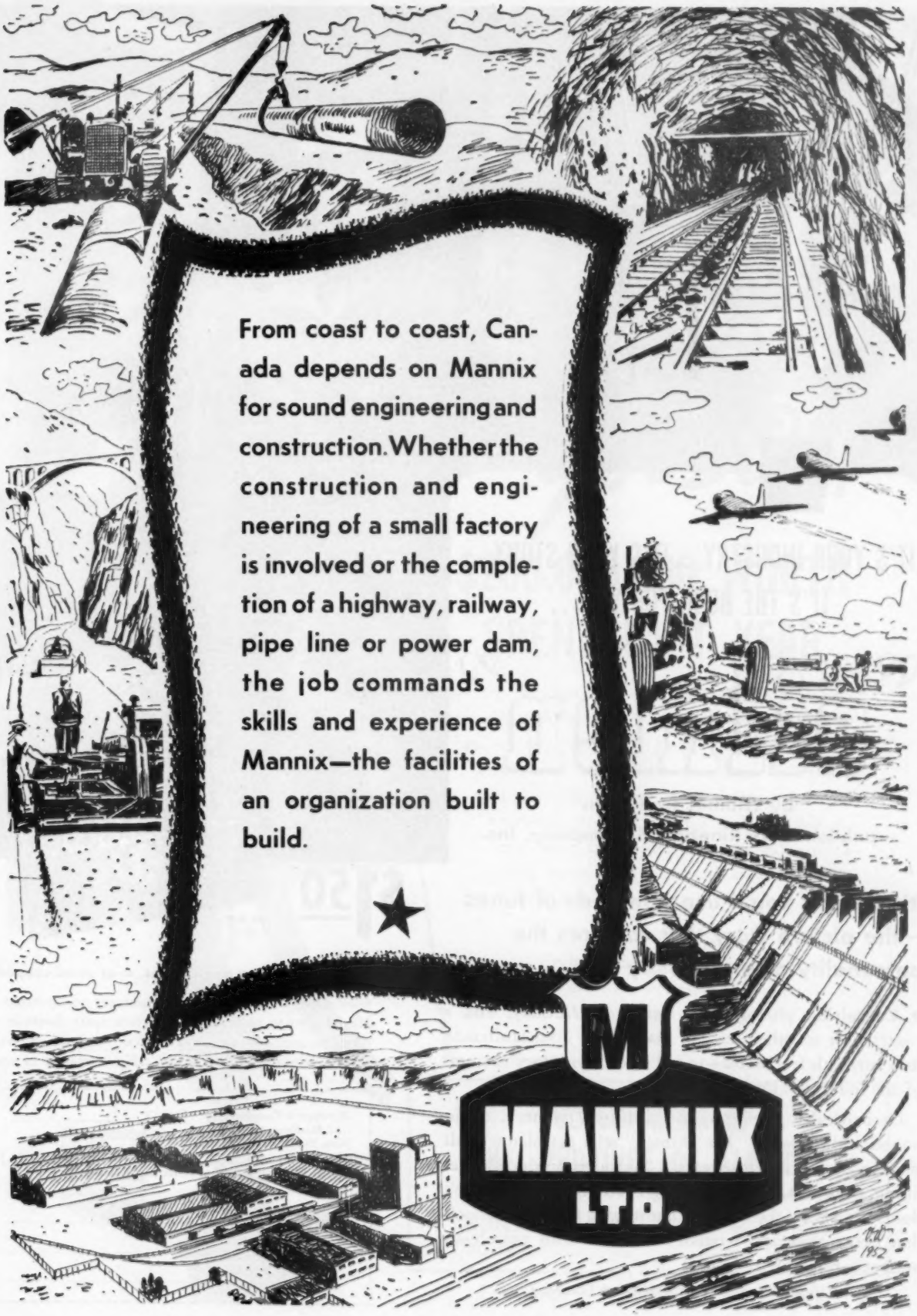
Amsterdam – The Netherlands

are now building on their sites in Amsterdam,
a plant for the production of

M.S. fluid cracking catalyst

according to the processes of
AMERICAN CYANAMID COMPANY
New York.

THIS PLANT WILL START PRODUCTION IN 1953


From coast to coast, Canada depends on Mannix for sound engineering and construction. Whether the construction and engineering of a small factory is involved or the completion of a highway, railway, pipe line or power dam, the job commands the skills and experience of Mannix—the facilities of an organization built to build.
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by Thomas Hollyman
—published by Rinehart & Company, Inc.

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It's a book you'll use hundreds of times —the picture story that captures the personality of an industry

● Consulting photographic editor of *Holiday,* and a contributor to other leading magazines, Tom Hollyman now turns his lens on *oil*—to tell its exciting story in terms of the industry's men and women.

Dramatically photographed, concisely written, cloth-bound and oversize, "The Oilmen" tells petroleum's full story from search to discovery . . . through production, refining, transportation, marketing . . . to the ultimate user's door. It's a book the industry has needed for years, a book that every man and woman associated with petroleum must see, read, own.

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Shell Oil Company and its employees co-operated with Mr. Hollyman to make this picture story possible—and offer this announcement as a service to the men and women who have made oil the nation's No. 1 source of energy.

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Please send me _____ copies of THE OILMEN @ $1.50.
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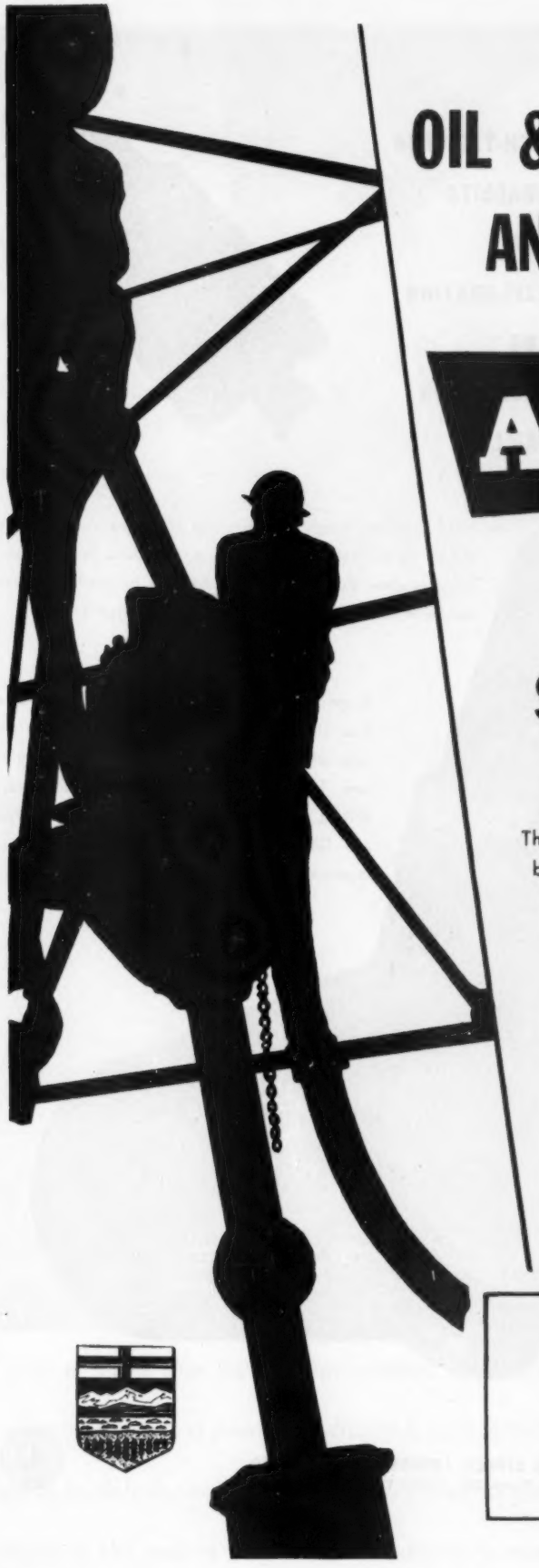

CANADIAN

OIL & GAS EXPLORATION AND DEVELOPMENT

in

ALBERTA

goes On!

$200,000,000 WORTH SPENT LAST YEAR

The big job goes on! Throughout the length and breadth of Alberta the mighty job of oil exploration and development is continuing to add more oil for Canada's oil hungry industries. Over 180 drilling rigs and 130 seismograph crews are now in full operation. An average of 3 wells per day are now being completed. Last year 451 exploratory holes were drilled and in addition 786 field development wells were drilled.

Alberta Government policies encourage private development of the Province's rich natural resources.

GOVERNMENT OF THE PROVINCE OF ALBERTA

Department of Mines & Minerals

HON. N.E. TANNER, Minister

I.N. McKINNON, Deputy Minister

Edmonton Alberta Canada

tough as they come

FISH-TAIL AND DRAGBITS FOR EXPLORATION AND PRODUCTION DRILLING

Hard-faced and tough, these bits take all the punishment handed out by the hardest and most abrasive formations. Service reports by users show that 'Carbometal' Bits can be used with great success in formations formerly needing roller-type bits.

A special grade of Titanium Carbide used to hard-face all 'Carbometal' Bits ensures toughness and long service life. Carbometals Ltd. also manufacture Titanium Carbide Hard-facing Electrodes, Drilling and Coring Crowns, inserts for Cross-type and Chisel-type Percussion Drills, and Diamond Impregnated Crowns.

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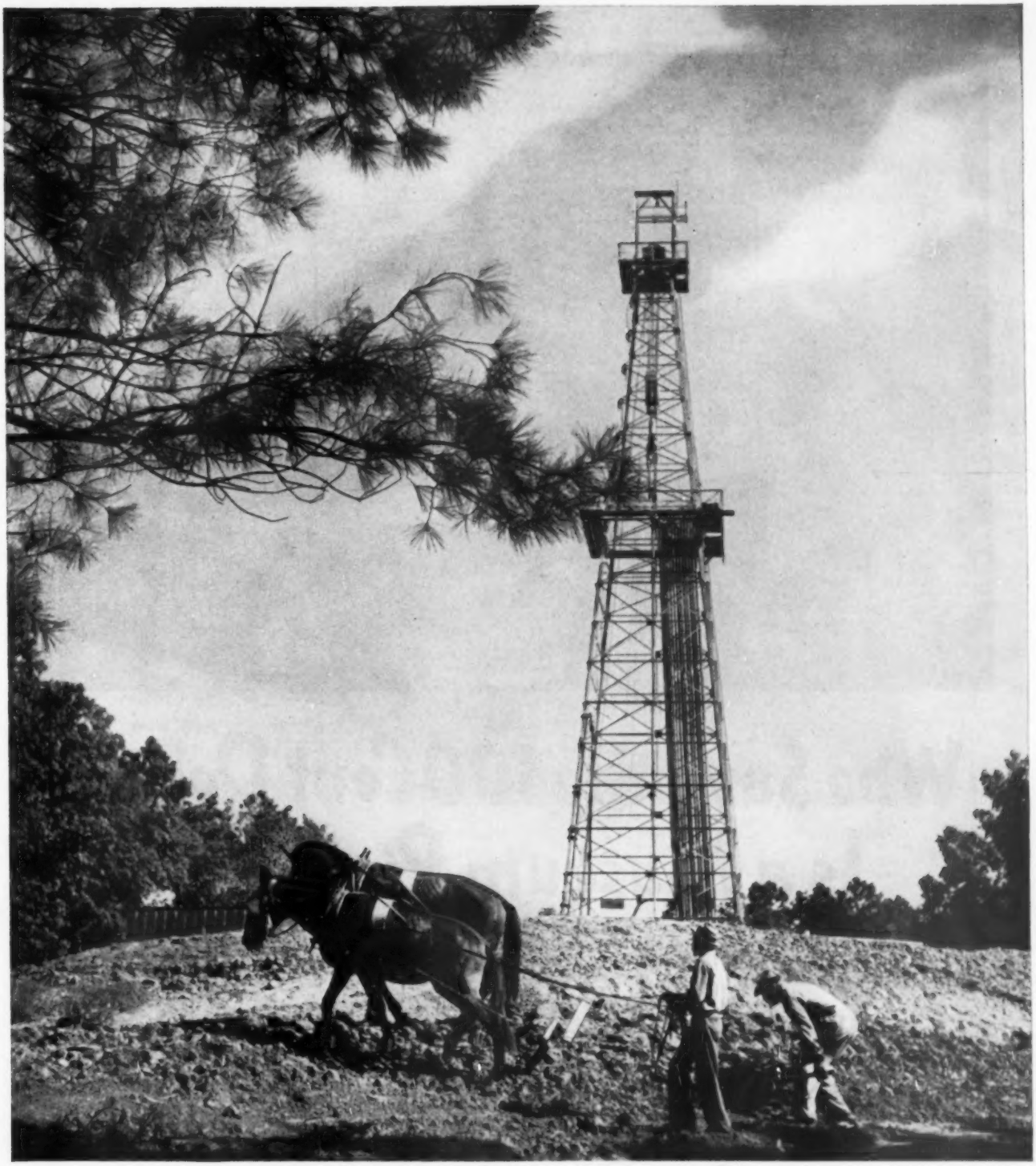
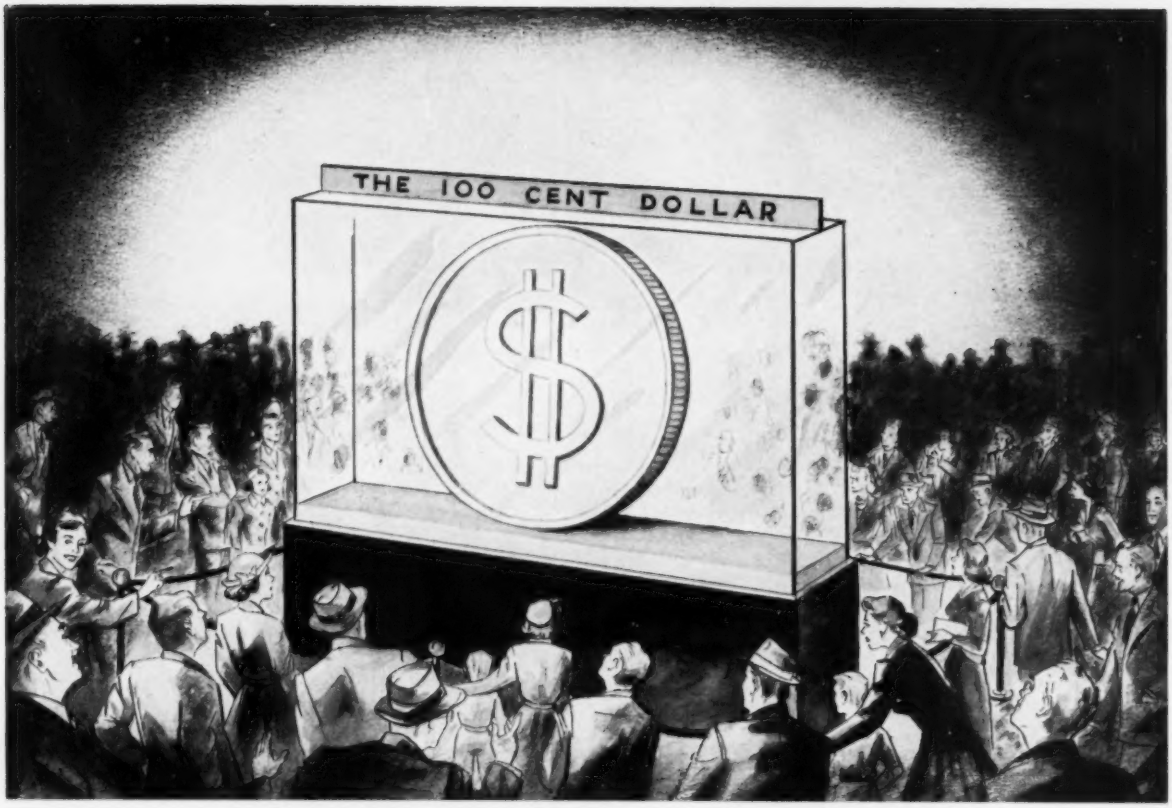


"Like a plant that takes nourishment from the soil and then replenishes it, a good investment is both productive and helps to enrich the soil itself—it contributes to the economic strength of the nation where the investment is made."

STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES



Who Says the 100 Cent Dollar Is a Museum Piece?

. . . Actually, the American Dollar buys *more* in Halliburton cementing service today than it did in 1924!

Earle P. Halliburton
Chairman of the Company
HALLIBURTON OIL WELL CEMENTING CO.
Duncan, Oklahoma

PETROLEUM CHEMICALS DIVISION
NEWS

May ★ One of a Series of Interest to the Petroleum Industry ★ 1952

Du Pont Purchases Plant Site in Texas

A 562-acre tract in the Beaumont, Texas area was recently purchased by the Organic Chemicals Department of the Du Pont Company. The Petroleum Chemicals Division, supplier of tetraethyl lead, is part of this department.

The plant site is bounded by the Neches River and the Kansas City Southern Railroad. Definite plans for plant construction on the new site have not yet been announced. The land, however, was purchased for the purpose of expanding the Company's regular manufacturing activities.

The location is conveniently close to an ample supply of petrochemicals ... used in making many Du Pont products. There are now three major Du Pont Company plants in Texas, at Sabine, Victoria and Houston.

NEW DU PONT MARKETING AID...

Unique Mileage Calculator Now Available for Your Special Gasoline Promotions

Why does a motorist select *your* gasoline brand . . . or your competitor's?

Miles per gallon is, no doubt, one of his most important considerations—because he can *see* how it affects his pocketbook. That's why many car owners are interested in keeping score on gasoline mileage.

By giving the motorist an interesting gadget that helps him determine his mileage accurately, you can gain his friendship . . . and often create a favorable impression for your brand.

The new Du Pont gasoline mileage calculator is designed to help you do just that. It is essentially a circular slide rule with simple settings that tally miles-per-gallon performance.

The calculator accurately figures the mileage on fuel measured to the nearest fifth of a gallon. And a handy indicator, which the motorist sets with each tank filling, automatically keeps track of his previous mileage. But the tank has to be completely filled at each gas stop to enable the motorist to maintain a continuing check . . . which is, of course, to your advantage.

Complete instructions, plus *your* trade-mark and brand name are printed on the front of the calculator. It carries no other advertising. This makes it an ideal tie-in for your special promotions —such as the introduction of a new or improved gasoline, the opening of a new station, or as a low-cost write-in item for testing your advertising or radio program.

The Du Pont calculator design is available to oil companies who, in turn, would have them made with their own brand name and trade-mark in any desired quantity.

New Visual Training Aid On Blending Plant Safety Developed by Du Pont

"Safety" is always a password to the successful handling of tetraethyl lead. And uniform handling procedures are of prime importance in maintaining safety in the blending area.

Since tetraethyl lead was first used in gasoline in the early twenties when Du Pont developed a safe commercial method for making it, a variety of methods for training blending personnel have evolved.

THIS NEW DU PONT TEL SAFETY PRESENTATION can be clearly seen by a group of 20. And it is specially designed for convenient handling by the training instructor or discussion leader.

Now, to fill the need for a single, easy-to-understand tool for training prospective blending plant operators, and as a refresher course for experienced personnel, a carefully detailed turnover presentation has been developed by Du Pont. And this new visual training aid may well become the standard for training blending plant operators throughout the country.

CLEAR, SIMPLE

Stressing "correct operating procedures" as a means to safety, the presentation convinces viewers that correct operation, while not difficult, *is vitally important*. And the presentation is fortified with plenty of "reason why" to make its message penetrating.

For clarity and human interest, the turnover is made up of a series of easy-to-understand illustrations and diagrams. The simple, straightforward text on the back of the turnover is readily visible to the instructor, either for reading verbatim or as a guide for

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

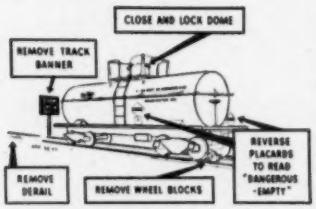
CONTINUED *Safety Turnover*

delivering the presentation with his own personal showmanship.

Big enough for visual impact, yet small enough for convenient handling, the 47 pages are 18⅝" by 24". Color has been added to many of the illustrations to show graphically and vividly the actual flow of liquids during the unloading and blending operations.

STEP BY STEP

The presentation is divided into two sections—tank car unloading and blending plant operation. Health precautions and the use of proper procedures are analyzed step by step.



A TYPICAL PAGE shows graphically the important steps in preparing a TEL tank car for release.

In addition to the actual turnover, protected by an attractive "Fabrikoid" binder, an "Instruction Manual" has been prepared to assist the speaker in the initial stages of becoming familiar with his presentation. The handy 8½" by 11" size of the manual permits the speaker to study his material at his desk, at home, on a plane or train without the necessity of handling the larger turnover.

NEVER.... touch anything contaminated with TEL compound without rubber gloves
ALWAYS.... bathe thoroughly after working with TEL ....

HUMOROUS FIGURES add interest to a serious point.

Suitable for either the novice or experienced blending crews, the new Du Pont turnover follows the style of the National Safety Council's "Safetygraph."

Coordinator of Du Pont District Laboratories

THE PROMOTION of ARTHUR F. BOWE to the position of Laboratory Coordinator was recently announced by the Du Pont Petroleum Chemicals Division.

Since 1949, Bowe has been manager of the Division's Eastern District Laboratory at Wilmington. This laboratory serves refineries on the Atlantic seaboard of the United States. He had previously been acting manager of the Gulf Coast District Laboratory at Houston, Texas, and supervisor of the analytical section of the Du Pont Petroleum Laboratory.

Before joining Du Pont in 1947, Bowe was with the Cities Service Oil Company at East Braintree, Mass. He was graduated, with a B.S. in chemistry, from Tufts College in 1939 and during his senior year was a teaching assistant in chemistry.

ARTHUR F. BOWE

Du Pont Historical Highlights

An early supplier of Du Pont was a Philadelphia firm that sold kegs to the powder mills. The containers were all sizes and qualities, causing confusion in sales and frequent losses from breakage and dampening of the powder. Later, Alfred Victor du Pont, son of the founder, built his own cooperage shop, designed a satisfactory standard keg and, thereafter, made the containers on the mill premises.

Today, containers, ranging all the way from paper envelopes to the tank cars carrying Du Pont's TEL, rank among the most important products Du Pont purchases. And Du Pont buys from more than 30,000 firms. Petroleum companies, suppliers of the petrochemicals used in making Du Pont products, rank well up among the firms supplying the largest volume of commodities bought by Du Pont.

MOVIES AND LITERATURE AVAILABLE

Here is a partial listing of the movies, bulletins, reports, booklets and aids available to you through the nearest Du Pont Petroleum Chemicals Division district office:

Safety for the Small Refinery — A 42-page book on how to set up an effective small refinery safety program ..... Serial A-2848

Stability of Present-Day Gasolines — A 12-page paper on the value of storage tests — as compared with induction period—for determining stability of modern gasolines . Serial A-3199

Pipeline on Wheels—A 26-minute, full-color movie on tank truck safety. Suitable for both training and public relations purposes.

Prints of Du Pont films are available to oil companies for training and public relations purposes. They may be borrowed or purchased.

DU PONT
REG. U.S. PAT. OFF.
Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

IN CANADA: Canadian Industries Limited — Toronto, Ontario — Montreal, Quebec — Calgary, Alberta

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

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Two Place Astra-Coupe designed by Richard Arbib for the VEEDOL Dream Car Salon.

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WHEREVER FINE CARS

TRAVEL

For All Cars... Old and New...

VEEDOL

The World's Most Famous Motor Oil

VEEDOL, product of the most modern and scientific developments in the petroleum field, is specifically designed to more than keep abreast of modern-day motor demands. VEEDOL is expertly refined to bring you great performance from the famous "Film of Protection" that keeps motors *safer, cleaner, smoother-running!*

TIDE WATER ASSOCIATED OIL COMPANY

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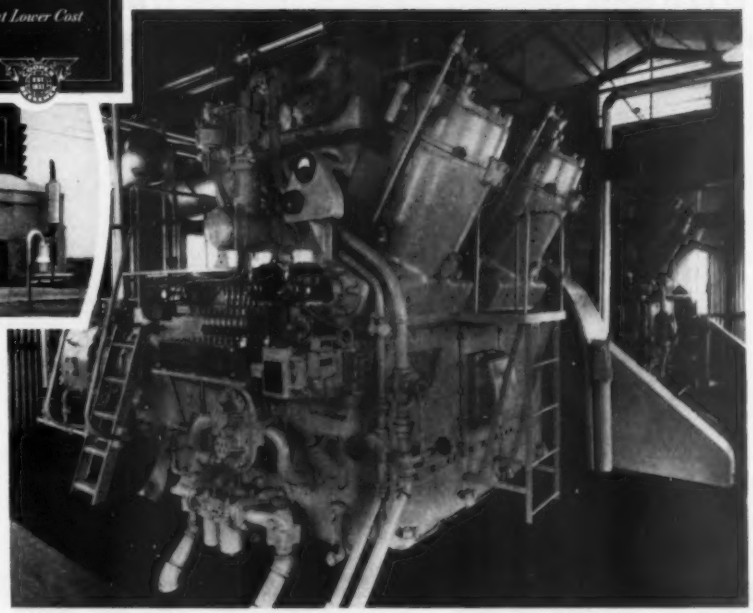
Another Example of Efficient Power at Lower Cost



These automatically controlled, 2-stage, 440 hp Cooper-Bessemer compressors take field gas at 20 psi and discharge at 425 psi into the pipe-line system of United Gas. Inset shows exterior of this new Universoil booster station in the West Beaumont field. Installation was handled jointly by Deerfield Petroleum, Inc., and Universal Petroleum Co., Oil Well Supply Co. furnishing all equipment.

RIGHT: Close-up of the operating ends of the modern GMV's from the crank-door side. Unusual flexibility makes these units ideal for automatic operation.

More profit in gas conservation...

...WITH GMV ONE-MAN AUTOMATIC OPERATION

WHEN a booster station practically runs itself, month in, month out, gas conservation is bound to be more practical, more profitable! And that's the success story behind those Cooper-Bessemer GMV V-Angles, shown opposite, in Universoil's new station in the West Beaumont field.

These two GMV's are daily handling 4,800,000 feet of gas that ordinarily would be flared—doing it efficiently *with the attention of one man for each 24 hours of operation!* It's a good example of the adaptability of modern Cooper-Bessemer V-Angles to extensive automatic control. The installation features variable speed governors to meet wide load variations, as well as automatic shutdown devices on the cooling water and lube oil systems. Likewise, the inlet scrubbers have low-liquid-level dump and shutdown controls.

If you're planning compressor jobs from 220 to 3,000 hp, automatically controlled or otherwise, check on Cooper-Bessemer V-Angles—today's and tomorrow's answer to compressor performance at its best.

The **Cooper-Bessemer** *Corporation*

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

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San Francisco, Calif. Houston, Dallas, Greggton, Pampa and
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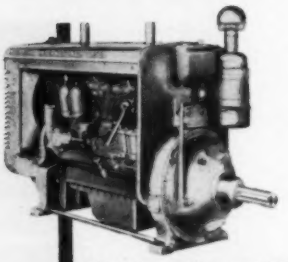
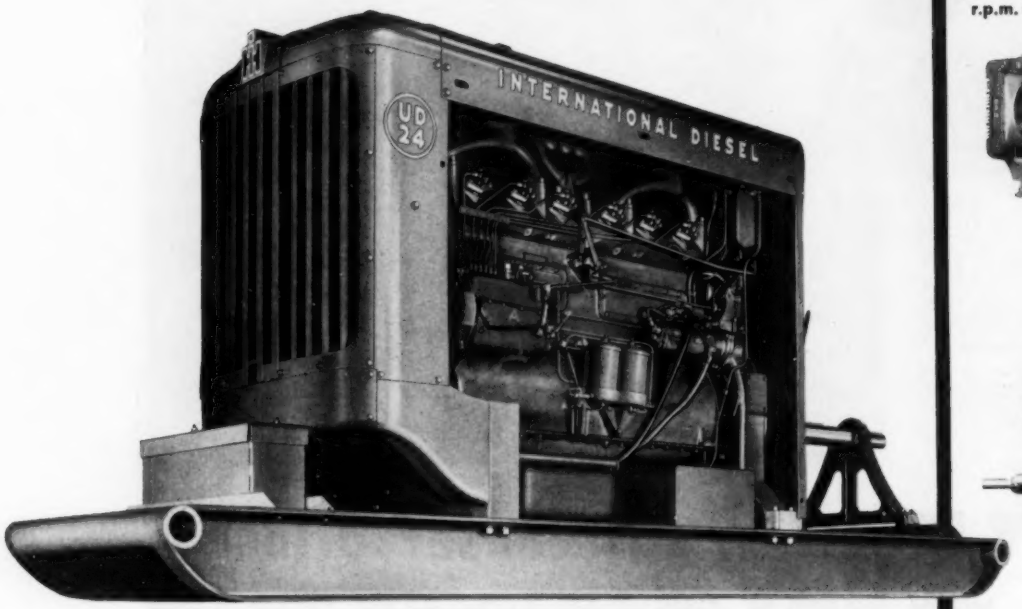
6 Diesel Power Units

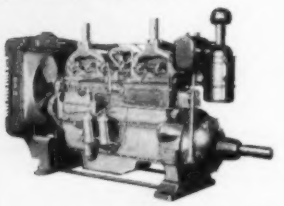
Each one backed by REPUTATION that has carried the International name throughout the world . . . ECONOMY proved by thousands of units giving dependable, low-cost performance . . . maintenance available from the SERVICE FACILITIES of your International Industrial Power Distributor.



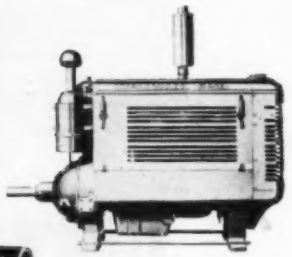
UD-18A, 125 h.p. at 1,600 r.p.m. 6-cylinder Diesel



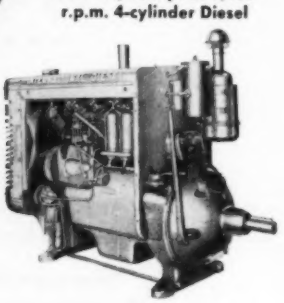
UD-24, 180 h.p. at 1,375 r.p.m. 6-cylinder Diesel



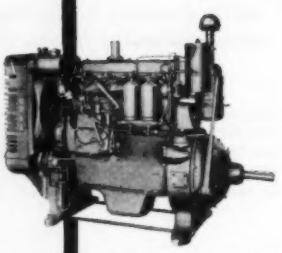
UD-16, 100 h.p. at 1,800 r.p.m. 6-cylinder Diesel



UD-14A, 76 h.p. at 1,400 r.p.m. 4-cylinder Diesel



UD-9A, 62.5 h.p. at 1,500 r.p.m. 4-cylinder Diesel



UD-6A, 45 h.p. at 1,600 r.p.m. 4-cylinder Diesel

The tremendous advantages offered by International Harvester are found on all the six continents. They are important factors in supplying world-wide industry with International Power Units and Tractors.

To you, the International Industrial Power Distributor represents these advantages. He specializes in application and service of this equipment . . . can give you expert guidance in selection of the right power unit for *your* particular requirements.

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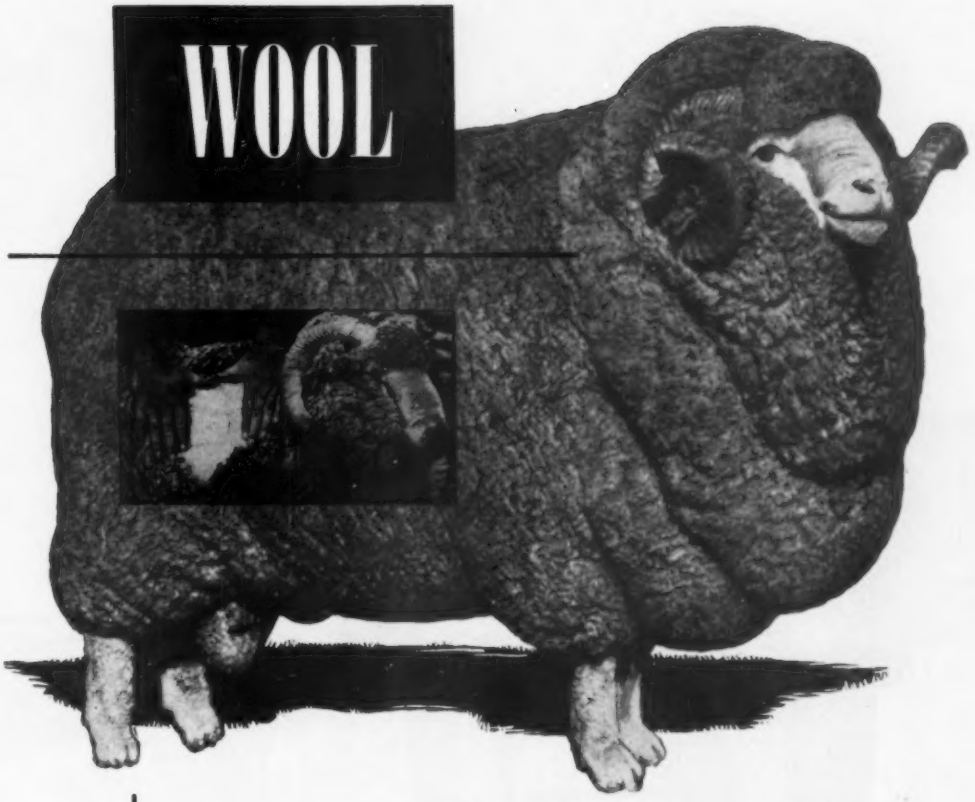
WOOL



wealth of the Commonwealth

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WOOL means warmth...
protection and
comfort for
man, woman, child.

And, throughout the world,
AUSTRALIAN WOOL
means **fine** wool...
soft, fleecy, **quality** wool.

Australia's
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today provide
1 out of every 4 pounds
of the world's supply...
more than half
of all the top-quality
Merino wool.

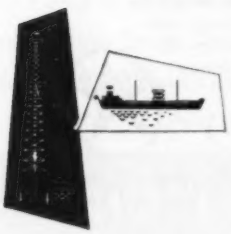
Wool is **one-third**
of Australia's
total export trade...
accounts for **one-tenth**
of the national income.

Another mighty important
commodity
to Australians is
OIL...

The petroleum products
which have aided
industrial expansion...
which give power,
light, warmth...
which fuel and lubricate
all manner of
modern transport.

More than a **billion**
imperial gallons
of oil products
each year
are the **life-blood**
in the arteries of
the Australian Commonwealth...
are helping to build
a stronger nation...
a better way of life
for the Australian people.

In Australia, as elsewhere
in the Eastern Hemisphere,
people know
they can depend on
the Stanvac organization
to supply this vital oil.



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Oil makes him an industrialist...

On the farms of America a big job is being done – growing the food to feed millions. It demands enormous skill and effort from the farmer, and dependable power and performance from the machines he uses. The development of many of these machines – which have helped turn farmers into industrialists – has been greatly helped by petroleum research. In fact, there is more horsepower on the farms than in all the nation's factories. And both modern farming and petroleum progress have been achieved, largely, by men working competitively in a system of free enterprise.

The Texas Company has served the farmers of America for many years – and hopes to continue to an even greater extent in the future.

The Texas Company

Faithfully yours 1902 | *for Fifty Years* 1952

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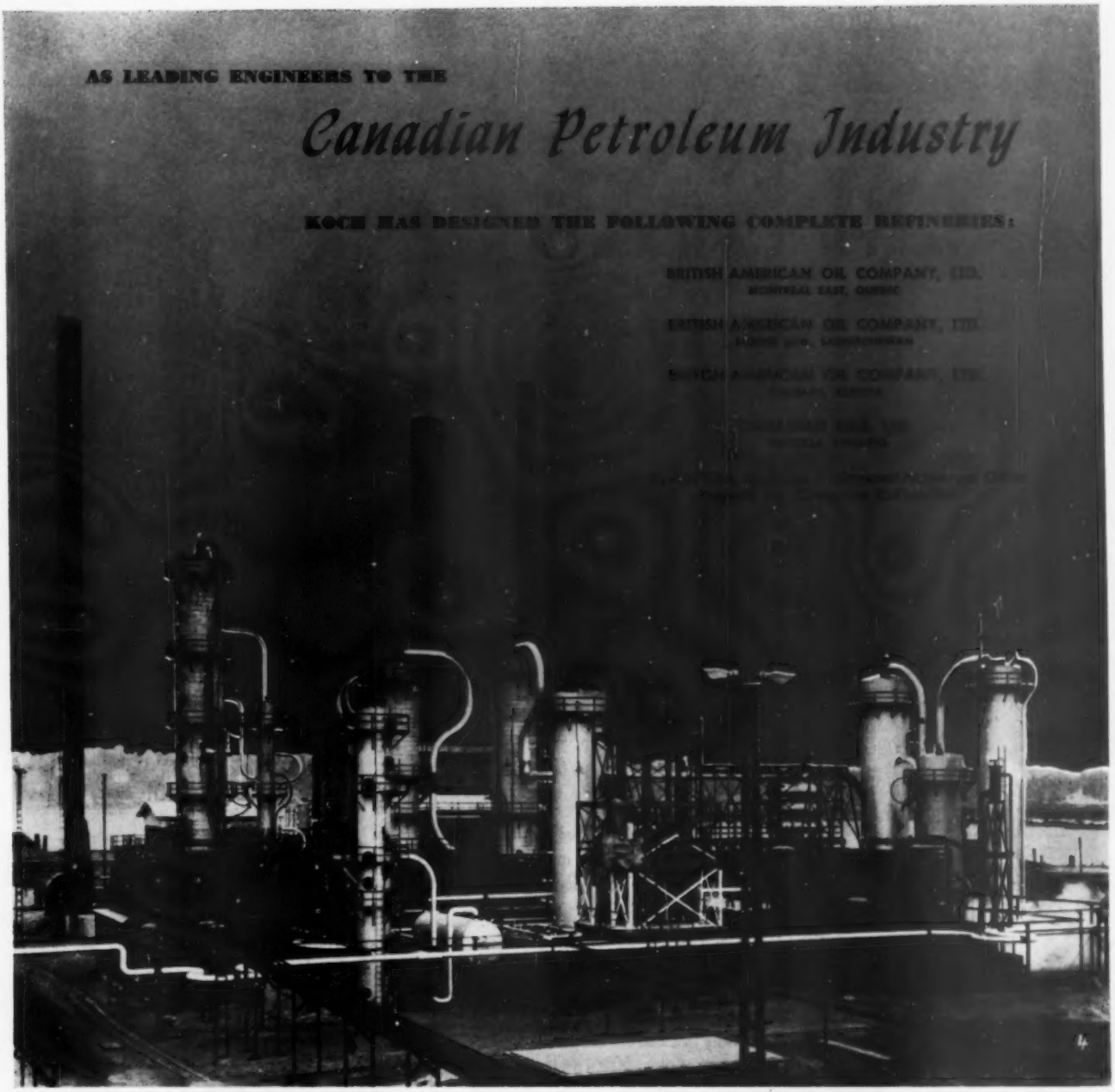

Koch designs and builds the following: Complete Refineries • Chemical Plants • All Types of Fractionators • Atmospheric and Vacuum Crude Distillation • Thermal Cracking and Reforming • Fluid Catalytic Cracking • Alkylation • Thermofor Catalytic Cracking Units • Catalytic Reforming • Perco Desulfurization • Close-out Naphtha Fractionation • Propane Deasphalting • Lubricating Oil Plants • Gas Compressor Stations • Natural Gasoline Plants • Evaluation of Refinery Installations and Operations.

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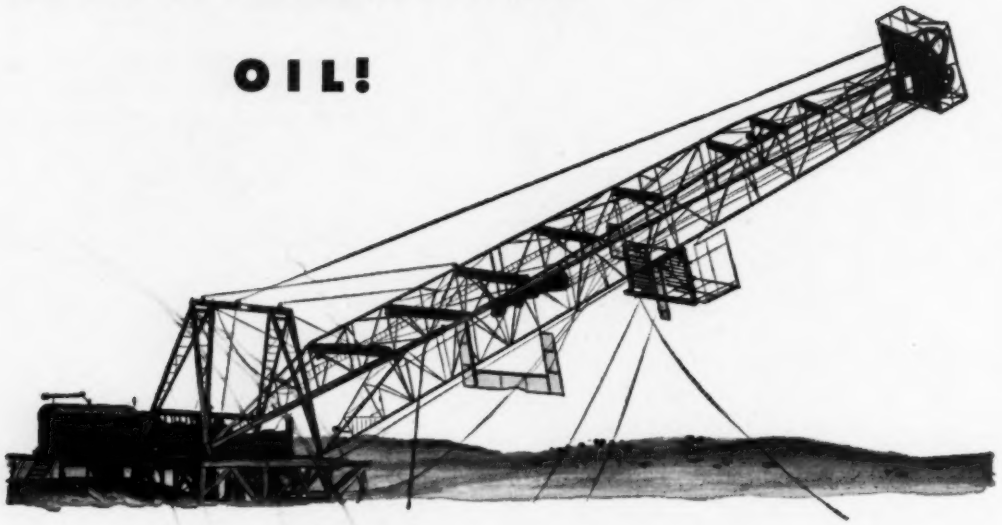

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is an important factor in the development of Western Canadian oil. Many men now in the field were helped by our wealth of experience in handling the financial problems of the oil industry.

Oil men are invited to consult our Petroleum and Natural Gas Division at Calgary. Our "banker-geologist" team provides a service of unique value to those interested in the opportunities offered by this great oil field. Why not call on us?

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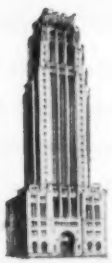
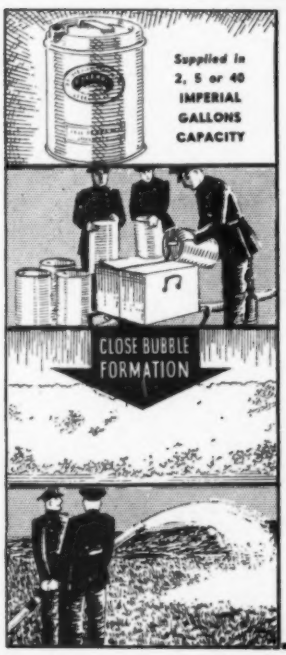


Kills Oil & Petrol Fires with SPEED & CERTAINTY



★ Nicerol is supplied in heavy gauge steel drums designed for quick release and clean pouring.

★ Nicerol can be used in any type of mechanical foam or air foam apparatus. In this case a base injection type in-line inductor is being operated.

★ The secret of Nicerol effectiveness lies in the small bubble formation. It creates a tough, efficient blanket. 3 gallons of Nicerol and 100 gallons of water will produce over 1,100 Imperial gallons of foam.

★ The above petrol and oil blaze was extinguished in a matter of seconds by a normal mix of Nicerol Foam Compound.

Meet the hazard of fire with Nicerol, the foam compound that kills any oil or petrol fire quickly and absolutely. Nicerol is a concentrate, producing a heavy type foam of closely-knit small bubbles which form a tough, vapour-tight blanket over the surface of burning oil or petrol. It is characteristic of Nicerol Foam that it flows with the fire and is highly resistant to flash-back or re-ignition. It can be used successfully in any type of mechanical foam or air-foam apparatus — is equally effective with salt water or fresh and can be stored for years without deterioration.

The Royal Navy and the Royal Air Force use it and so do Oil Companies, Fire Equipment Manufacturers, Civil Air Lines, several Commonwealth and Foreign Government departments, and Fire Brigades throughout the world. What better recommendation?

TRADE ENQUIRIES INVITED

For further particulars, samples, catalogues, etc.:

NICEROL LIMITED, LISBURN, N. IRELAND

Telephone: Lisburn 2027 *Telegrams: Nicerol, Lisburn*

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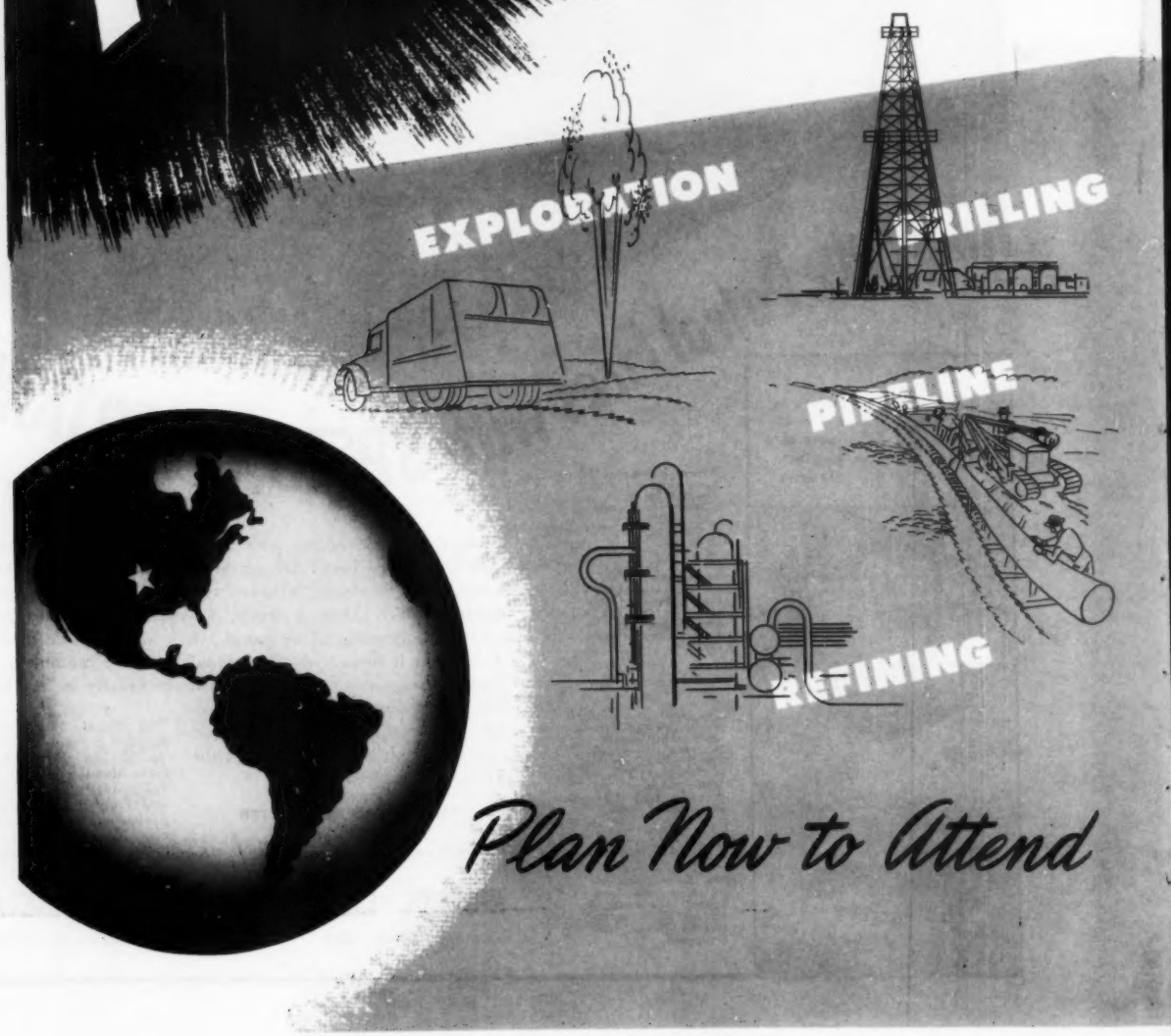

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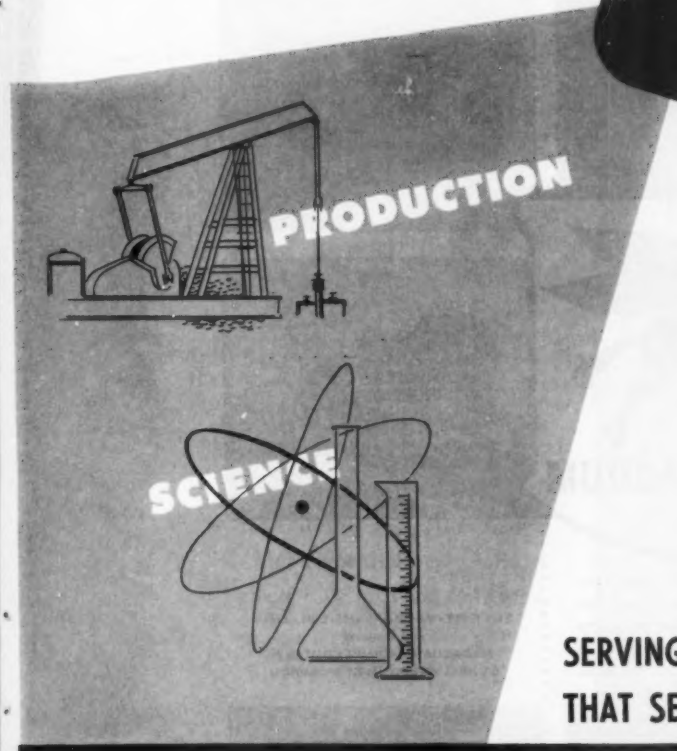
WORLD'S LARGEST INDUSTRIAL SHOW

PLAN NOW TO ATTEND. Executives, engineers, superintendents, contractors, purchasing agents and thousands of other employees of the oil and gas industry will take advantage of the opportunity to study the exhibits.

TULSA
MAY 14-23
1953



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OF OIL PROGRESS

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regarding space and rates,
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SERVING THE PETROLEUM INDUSTRY
THAT SERVES THE WORLD TODAY

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FOR EVERYTHING THAT RUNS_

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ON highways and skyways . . . rails and ocean lanes—for every type of engine there are Flying Red Horse products to provide peak power and protection. Constant research keeps these products unsurpassed in quality . . . assures Flying Red Horse leadership in meeting the requirements of present—and future—engine designs.

SOCONY-VACUUM OIL CO., INC.
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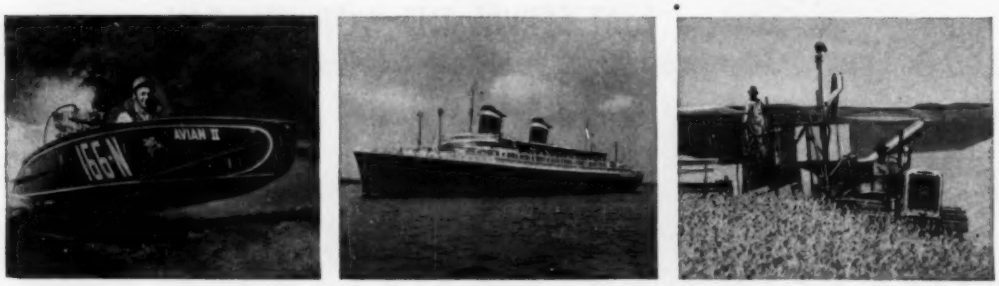
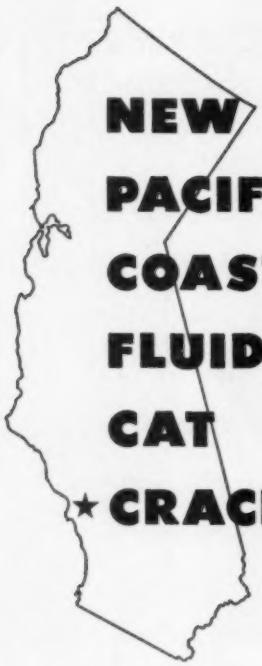
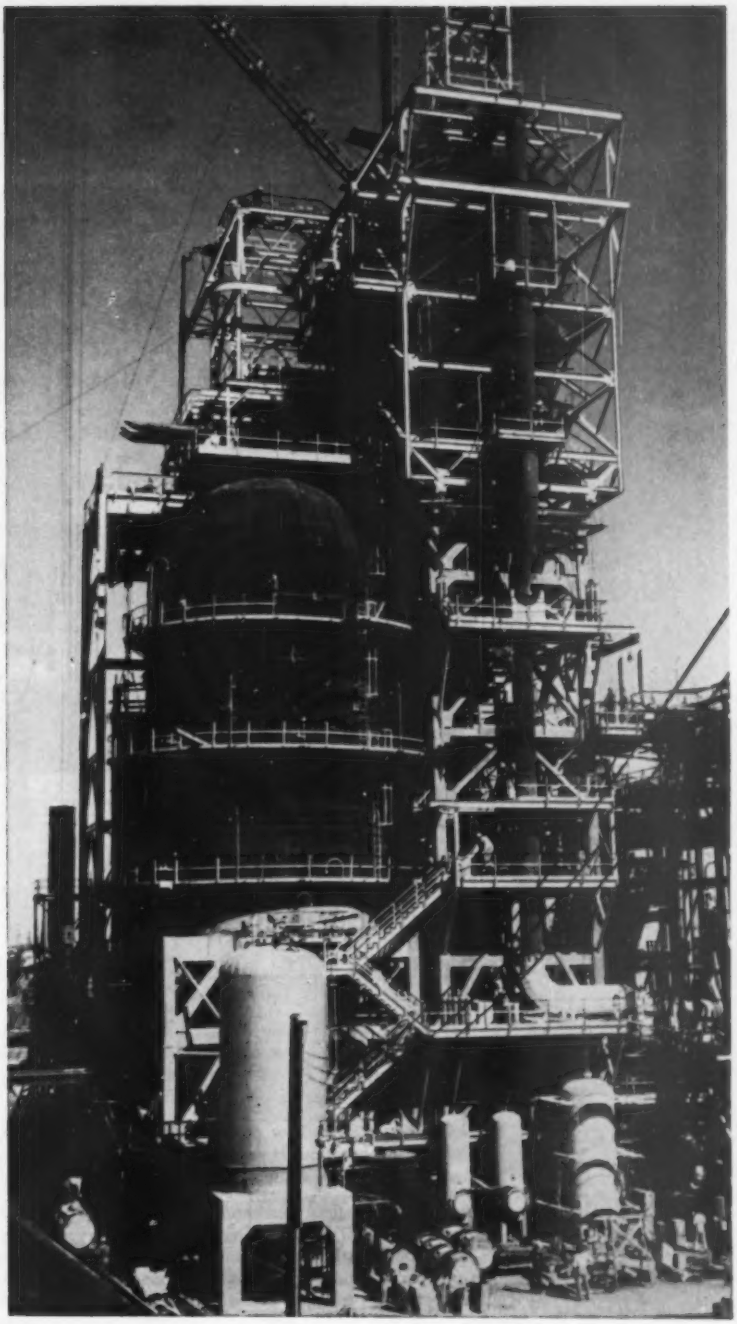




NEW PACIFIC COAST FLUID CAT ★ CRACKER



THIS new 28,500 B/D Fluid Catalytic Cracking Unit nearing completion at Wilmington, California, is being built by Arthur G. McKee & Company for the Union Oil Company of California.

DESIGN, ENGINEERING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

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Arthur G. McKee & Company • Established 1905

Headquarters: McKee Building, 2300 Chester Avenue, Cleveland 1, Ohio.
New York Office: 30 Rockefeller Plaza, New York 20, N.Y. • *Washington Office:* 1507 M Street, N. W. Washington, D. C. • *England:* The Iron and Steel Division of Arthur G. McKee & Company is represented by Head, Wrightson & Company, Ltd.
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The Logical "Next-step" in Economy and Efficiency . . .

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INE CATALYST FLOW . . . THE CRACKER WITH STRAIGHT-LINE CATALYST
FLOW . . . THE CRACK
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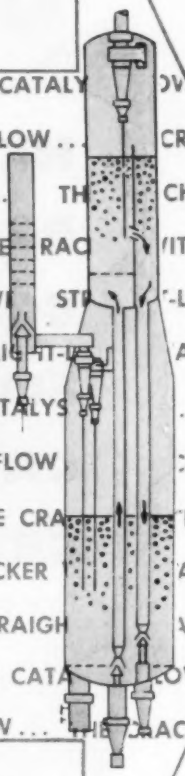
ITH STRAIGHT-LINE CATALYST FLOW . . . THE CRACKER WITH STRAIGHT-LINE CATALYST FLOW . . .

Kellogg Orthoflow



ORTHOFLOW, the latest Kellogg advancement in Fluid catalytic cracking, not only merges reactor and regenerator into a single vessel, but provides *straight-line transmission* for both catalyst-oil mixture and spent catalyst—in a system free from slide-valves and expansion joints.

As a result, **Orthoflow** costs less to build, costs less to maintain and is more flexible in operation. It requires less structural steel, smaller foundations, simplified piping. Straight-line catalyst flow minimizes erosion and increases efficiency.

An **Orthoflow** unit can handle practically any feed-stock, from kerosene to the heaviest gas oil. High-boiling stocks are charged as liquids and vaporized by the hot catalyst, with minimum use of pre-heat facilities. Furthermore, **Orthoflow** units permit wide latitude in conversion . . . operate effectively over a wide range of feed rates to meet changes in a refinery's requirements.

Orthoflow, the logical "next-step" in catalytic cracking progress, derives from Kellogg's basic experience—dating from the inception of Fluid catalytic cracking—and the engineering of more than 70 percent of the world's total Fluid cracking capacity.

The latest issue of the KELLOGGRAM —"From Baton Rouge to Orthoflow"— presents the details on this new cracking development. Available on request.

THE M. W. KELLOGG COMPANY

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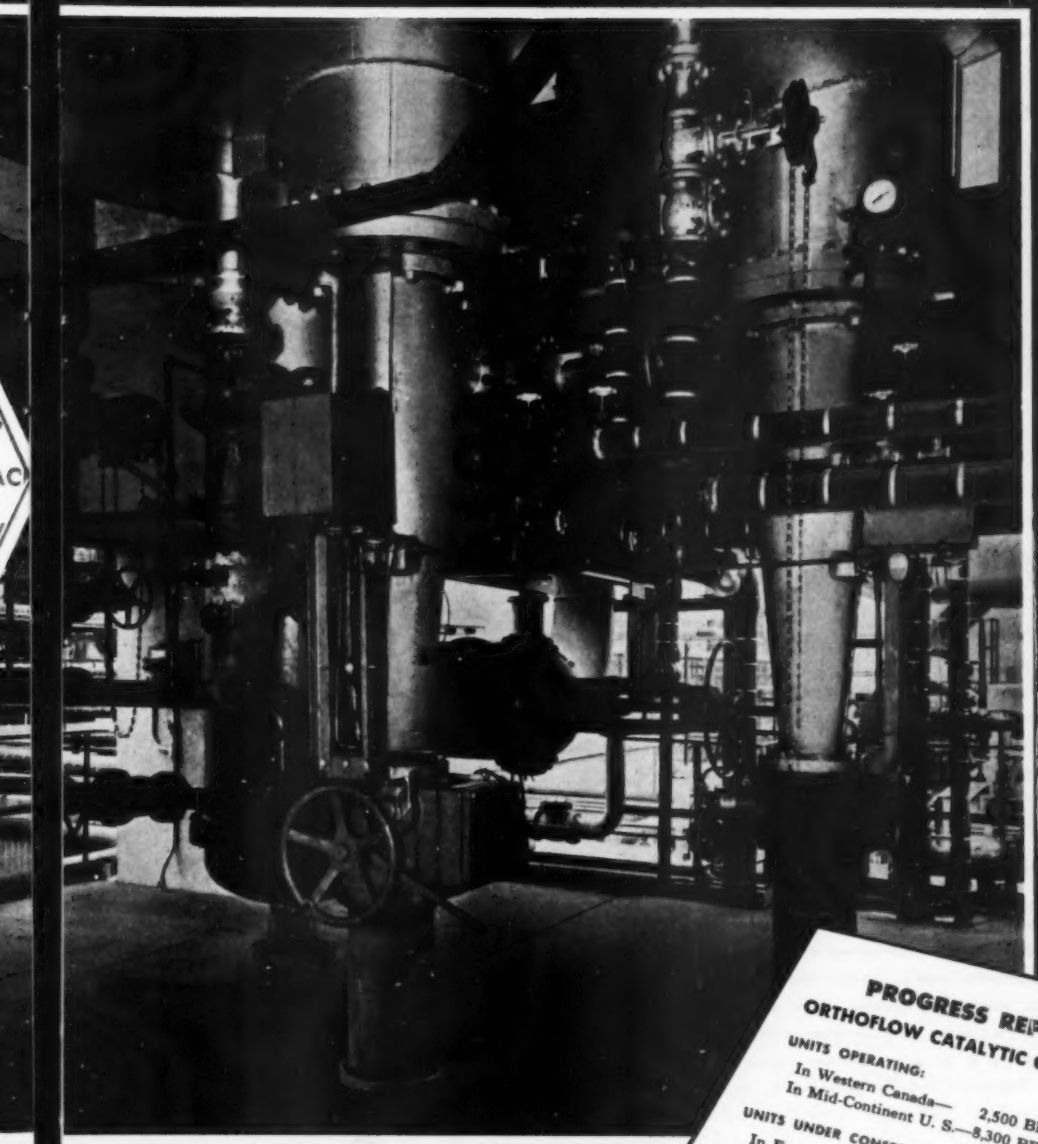

PROGRESS REPORT
ORTHOFLOW CATALYTIC CRACKERS

UNITS OPERATING:
In Western Canada— 2,500 BPD Unit
In Mid-Continent U. S.—8,300 BPD Unit

UNITS UNDER CONSTRUCTION:
In Eastern Canada—8,300 BPD Unit

UNITS IN ENGINEERING:
On the Atlantic Seaboard—28,000 BPD Unit
In Mid-Western U. S.—17,000 BPD Unit
On the Gulf Coast—26,000 BPD Unit
In Europe—5,000 BPD Unit

.....for fifty one years an integral part of petroleum refining progress!

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Consult STONE & WEBSTER CANADA LIMITED

Many American businessmen are today considering the opportunities for business in Canada. Many American corporations have already established offices and plants up north. If you are in either group, Stone & Webster can help you.

How? With a technical report, an appraisal or a survey to assist you in selecting your new plant location; with a highly competent and thoroughly experienced engineering and construction staff to design and build your new plant and facilities. Stone & Webster Canada Limited, our Canadian subsidiary, is prepared to bring to Canadian industry and to American industry planning to expand into Canada the same high standards of performance that our clients in this country have come to expect and appreciate.

In addition to having at their command the services of our engineering and construction organization, Stone & Webster Engineering Corporation, which includes its Badger Process Division, clients of Stone & Webster Canada Limited may, at any time, call on the Stone & Webster Service Corporation for assistance in the solution of problems involving business management or on the Stone & Webster Securities Corporation for advice on questions relating to financing or refinancing.

Your inquiries are cordially invited.

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90 BROAD STREET • NEW YORK 4, N. Y.
STONE & WEBSTER CANADA LIMITED, 44 KING STREET WEST, TORONTO

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and every kind of fitting,
including buttwelding seamless tees,
bends, reducers and welding-neck flanges
for building up welded pipe systems.

S&L

STEWARTS AND LLOYDS LIMITED
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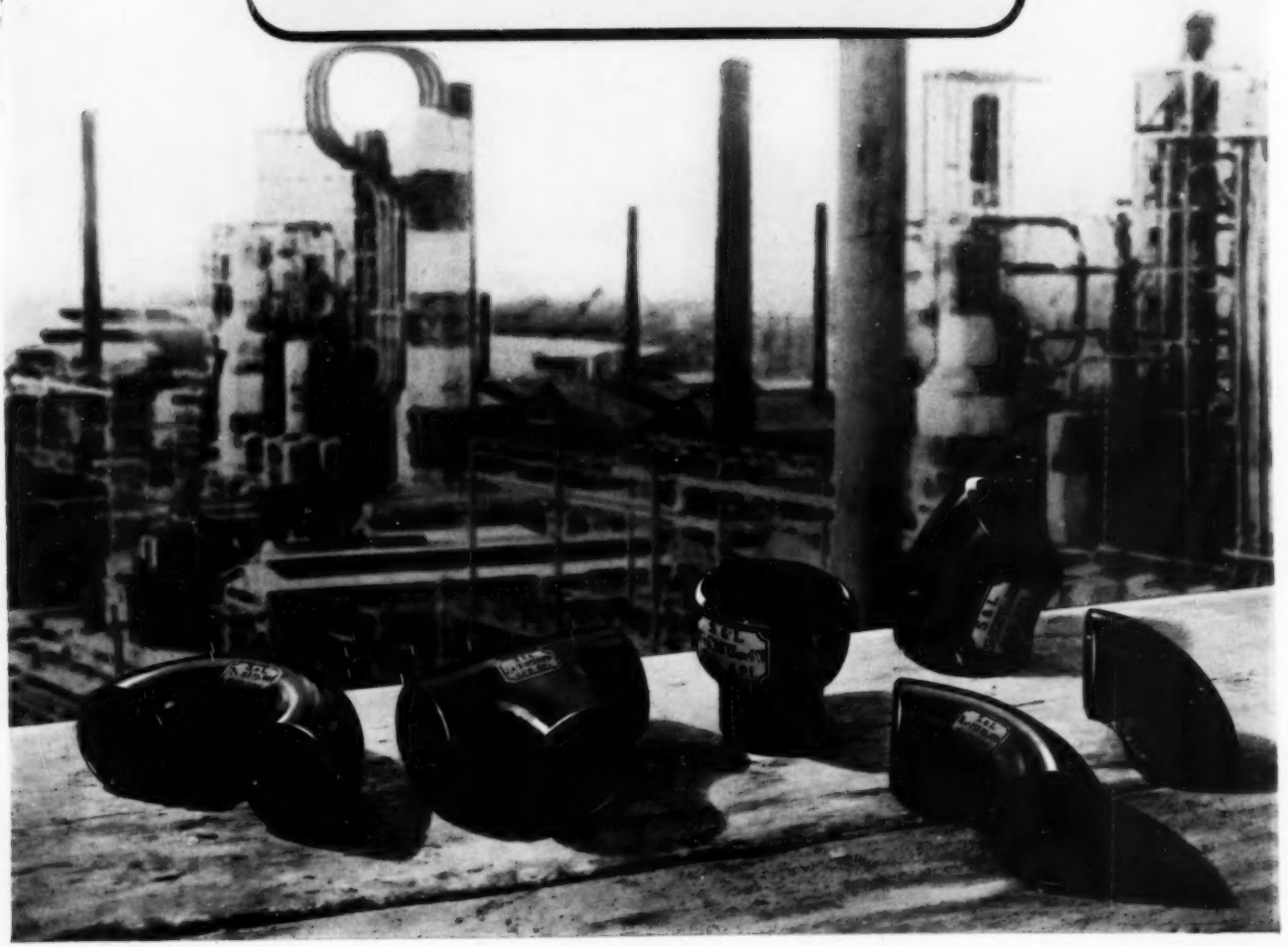

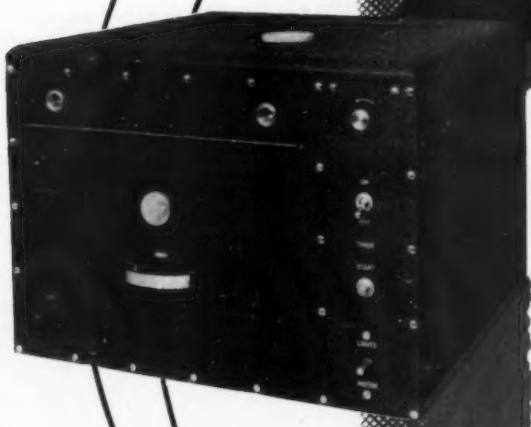

Camera

Only a good camera can produce a record of high quality from superior geophones and amplifiers.

The SSC camera has been designed as a component part of the geophone-amplifier-camera group. Ruggedness, ease of operation and good photography are combined to produce a high quality record.

SSC is constantly striving to provide a more effective seismic exploration service for the petroleum industry.

Seismograph Service Corporation

Seismic Surveys – Gravity Surveys – Pilot Crews – Lorac

TULSA 1, OKLAHOMA, U.S.A.

Foam Compound News

Some facts about the development of fire fighting foam

Foam Compounds have been developed from time to time, in accordance with the particular type of mechanical foam equipment in vogue.
Some foam compounds give good foam with one type of equipment; and bad foam with another; but a good-looking foam is no measure of its usefulness on a fire, because its fire resistance cannot be determined by visual examination. The development of mechanical foam equipment has been, in the main, along two broad lines, each fundamentally different in the principles of foam production:—

(a) Foam Pumps.

(b) Foam-making Branchpipes and Mechanical Foam Generators as produced by The Pyrene Company, and used in many ways from portable, hand-operated appliances, to the largest sizes of fixed units for Oil Storage Tank Protection; and for Foam Tenders for Oil Refineries and Storage.

Foam pumps are of the positive, rotary type and generally based upon the Danish designs of Schroder and Van Deur and Ellehammer. These power-driven units take in water, foam compound and air in controlled proportions, beat the mixture into a foam and pass it through an improver on the way to the delivery.
The Pyrene Foam-making Branchpipe (or generator) operates from a supply of pressure water, and this in turn induces foam compound and air, forcibly mixing them together to produce foam. The size of a unit is limited only by the capacity of the water supplies available.

Fire resistant foam

Almost any type of foam compound can produce a good-looking foam which may, or may not, have fire resistance when used in conjunction with foam pumps, largely because of the mechanical power available from the motive unit. For use with the foam-making branchpipe a more selective, and much more refined foam compound, is necessary to give good results.
Omitting details of the intervening development years, there are now two types of foam compound, which are best described as "Standard" and "Low Viscosity". As the original makers of foam branchpipes and foam compound in this country, it will be appreciated that the special grade of foam compound which we developed, and which in fact we still produce, has properties and a viscosity to suit the operating conditions under which our equipment will be used, and this grade is known as "Standard". It was found, eventually, that this compound also gave a foam having all the required properties, including that of fire resistance, when used with foam pumps.
It was known to us that the size of the foam compound supply lines on air foam pumps was not large enough to carry foam compound adequately of the viscosity of the Pyrene "Standard" grade. To meet this condition we therefore developed our grade "D" or "Low Viscosity" compound and have supplied this for many years, and are still supplying it in large quantities to the Government Departments concerned.

Animal blood compound

In the early days of the war the Chemical Research Laboratory, Department of Scientific and Industrial Research investigated the raw material position of foam compound, with a view to finding a home supply as an alternative to an imported product. They eventually issued a specification which would permit manufacture of foam compound from animal blood, based on low viscosity, in order to meet Service requirements of existing foam pumps. This was a useful wartime precaution but The Pyrene Company never found it necessary to depart from their original product except as mentioned above for use in air foam pumps.
Blood compound to the C.R.L. specification has now been commercialised and has become an available supply.

The advantages of Pyrene "Standard" Foam Compound

The Pyrene Company still adhere to their original "Standard" viscosity as being the best type for use in their equipment. One major advantage of using "Standard" viscosity compound is that a substantially less quantity will be used in foam branchpipes and mechanical foam generators during a fire, thus conserving manpower and transport and reducing the number of empties to be disposed of.

The viscosity figures of foam compounds are as follows:—

Pyrene "Standard" Grade:—	30-centistokes at 20°C.		
Pyrene Grade "D" (Low Viscosity):—	10-	"	"
Others:—	10-	"	"

The Pyrene Company have made tests with their normal equipment, to demonstrate this fact, with the following results:—

	Water *g.p.m.	Pyrene Std. Comp. *g.p.m.	Pyrene Grade "D" *g.p.m.	Other L.V. Comps. *g.p.m.	Increased % of L.V. Comp. used over Standard
Pyrene F. B. 10 Branchpipe	94.5	5.4	6.4	6.4	19
Pyrene M.F.G. 10	126	4.6	5.5	5.5	19
Pyrene Proportionator	103	4.4	5.4	5.4	23
Pyrene Inline Inductor	90	4.7	5.6	5.6	19
Pyrene Multiple Jet Inductor	95	3.5	4.3	4.3	23

*Imperial gallons.

The above figures are of the utmost importance to users of Pyrene Mechanical Foam Equipment.
Taking as a basis that, under ordinary operation conditions, 19/23% more L.V. compound would be used than would be the case with Pyrene Standards, this would mean the actual cost of compounds used would be 20% greater. 20% more compound would have to be transported to the site and manhandled there, and stocks of L.V. held would only represent 80% of the fire extinguishing capacity of Pyrene "Standard" Foam Compound.

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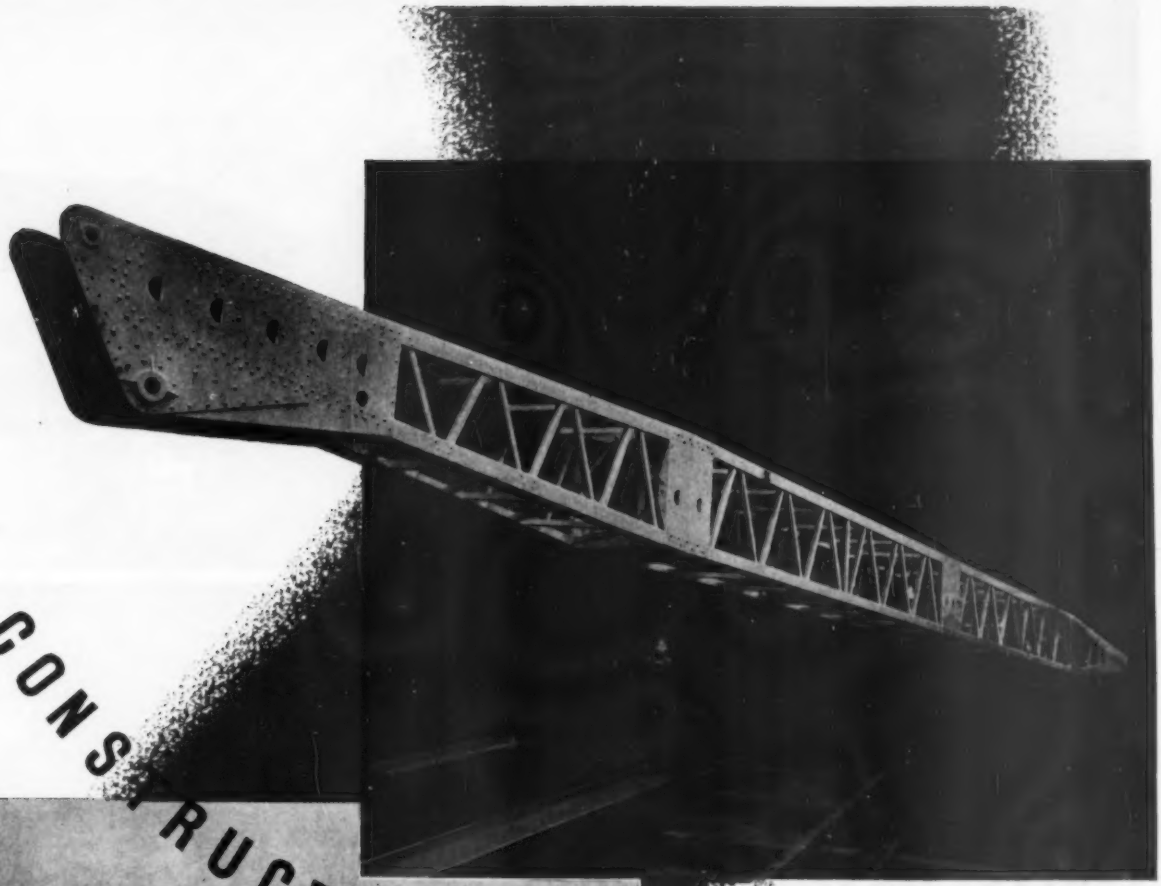

150ft. Mild Steel Riveted Derrick Mast photographed in the Butterley Constructional Department.

CONSTRUCTIONAL STEELWORK by

A view taken in the

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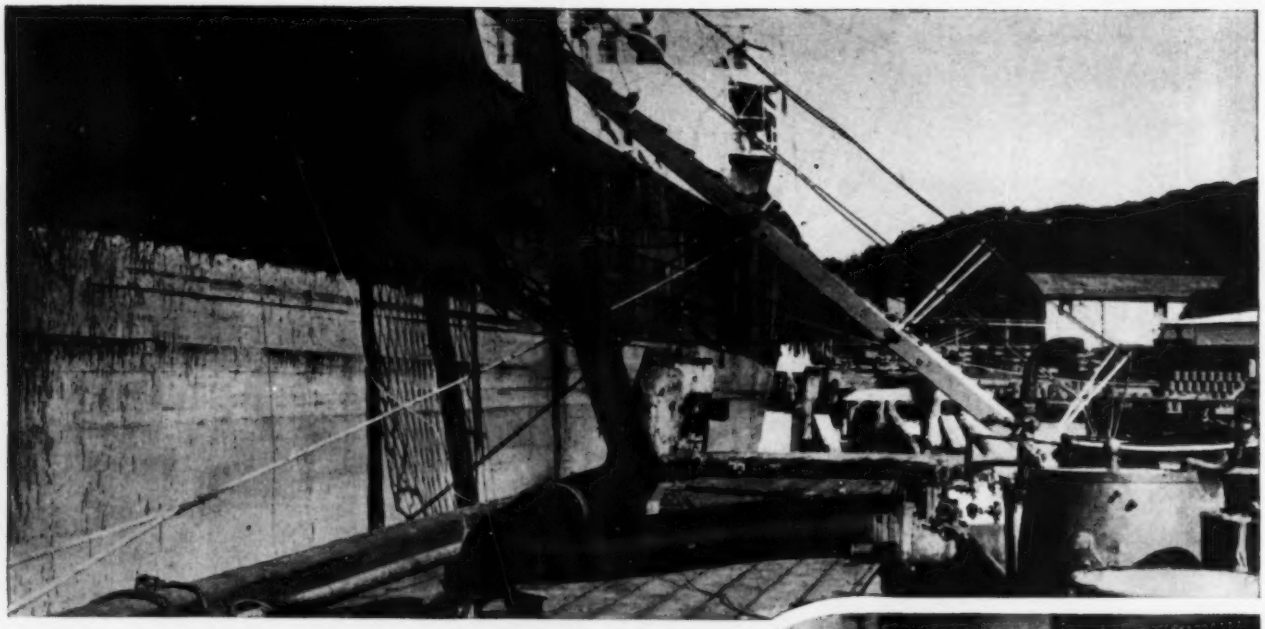
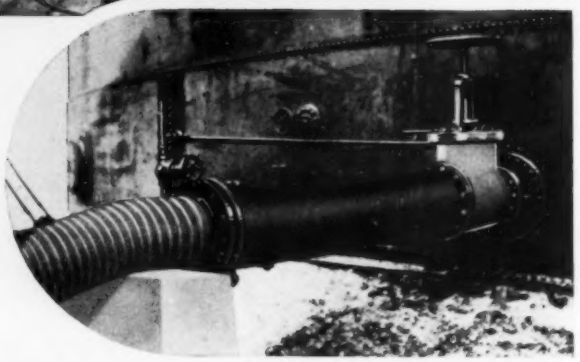


Dunlop clipless-type sea-loading hose discharging crude oil in Australia. Hose of this type, which incorporates high-quality, hard-wearing, oil-resistant synthetic rubber compounds, is capable of handling many tons of liquid per hour. Built of strong fabrics and internal wire reinforcements, it has a long and efficient service life.



Dunlop clipless-type oil suction and discharge hose bridging the gap between a pipe line and a storage tank in Holland.

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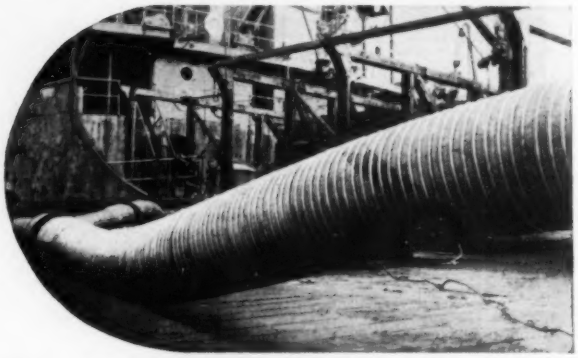
If you have a problem that may involve any of the products listed below or pictured above — which have been developed by Dunlop from an intimate knowledge of the conditions of use—get in touch with your nearest Dunlop representative or distributor. Or, if you prefer, send your enquiry direct to the address at the foot of this announcement.



Large bore, externally wire-armoured suction and discharge hose of an alternative variety operating in New Zealand. This type of hose is being largely superseded by the smooth cover, wire-embedded variety of hose illustrated above.

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Test tube "magic" makes the front page

Last year, newsprint represented more than a fifth of Canada's export to the United States . . . in dollar volume.

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Thus, the opening this year of Shell's sulphur plant at Jumping Pound, Alberta, was an event of very real importance to the great Canadian pulp and paper industry and another example of Shell's partnership with Canadian business.

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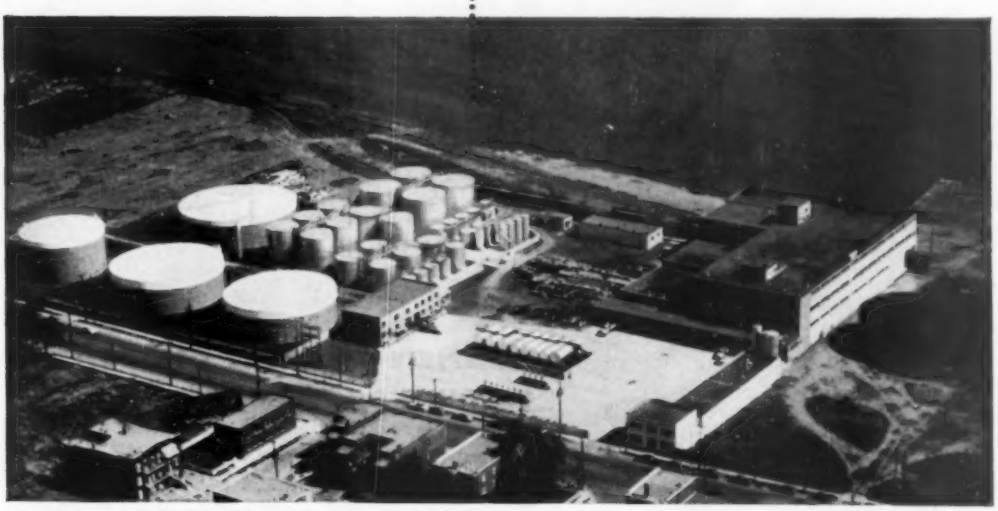
This lucite, scale model was the "blueprint" used by Fluor engineers to plan and construct the new modern lubricating oil and grease manufacturing plant for Canadian Oil Companies, Ltd., in Montreal. Being able to work out detailed designs in miniature, played a big part in the successful selection and location of all equipment to facilitate the natural flow of work through the plant with a significant saving in man hours. It is an example of the thoroughness with which Fluor tackles a job.

Over 300 varieties of specially engineered greases and lubricants packed in a multitude of sizes, from 3 ounce cans to 55 gallon drums, are manufactured, blended, packaged and stored in this efficient plant. It had to be built in a U-shape to incorporate the original plant which still houses much of the blending machinery. It had to be accessible to all forms of transportation by land or water. It had to provide storage facilities for raw grease stocks before processing and for interior storage of finished products. It had to be equipped with the latest automatic devices for heating, blending, sterilizing, conveying, packaging, handling, etc. and it had to be completed in the shortest time possible.

Fluor's experience with building and remodeling plants which use bulk materials for a variety of products, has long been established, but at Canadian Oil much of the machinery is Fluor designed—especially that used for handling materials. The flexibility of this equipment is almost human in its ability to switch from one type of product to another, from one type of container to another and from one type of carrier to another whether it be truck, box car, tank car, freighter or tanker, without loss of time for change-over.



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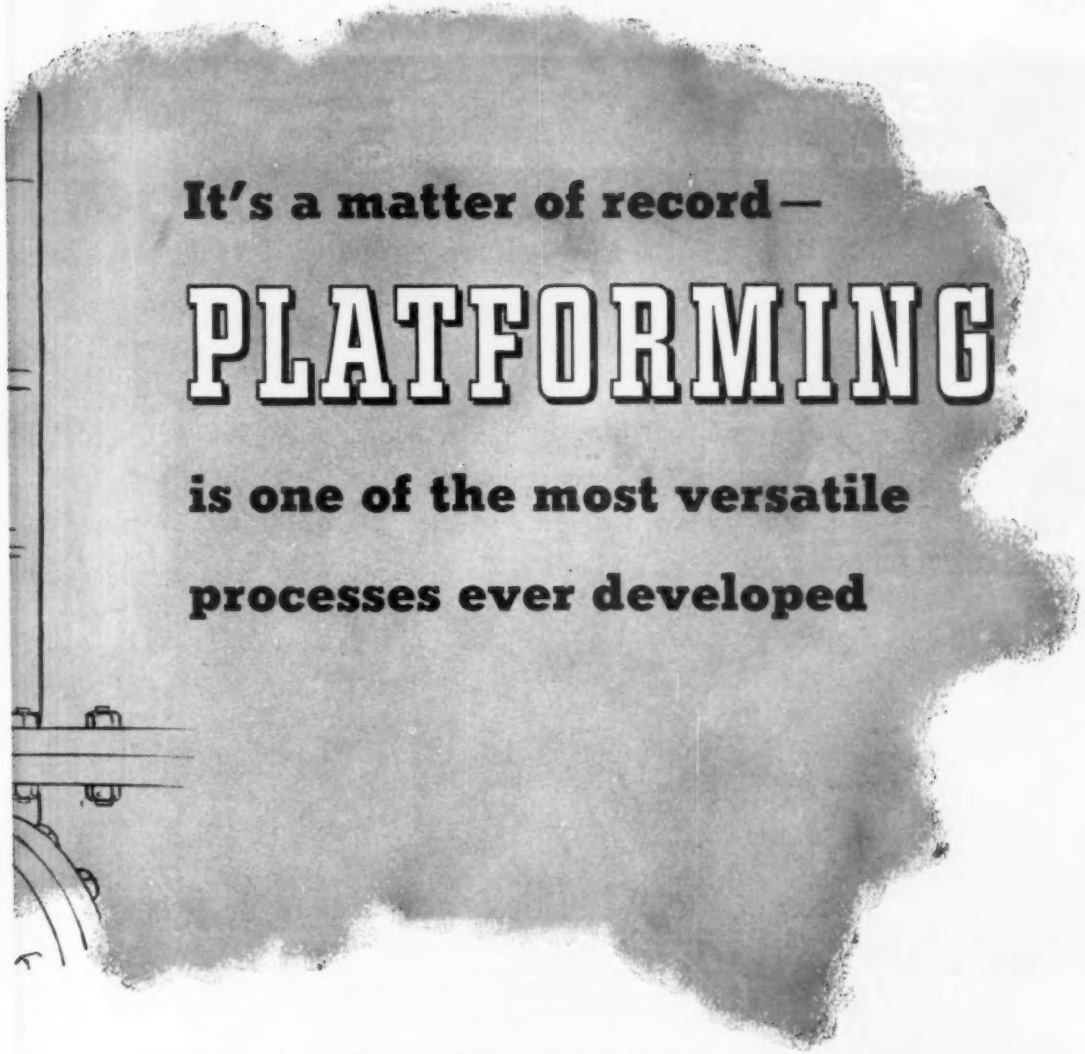

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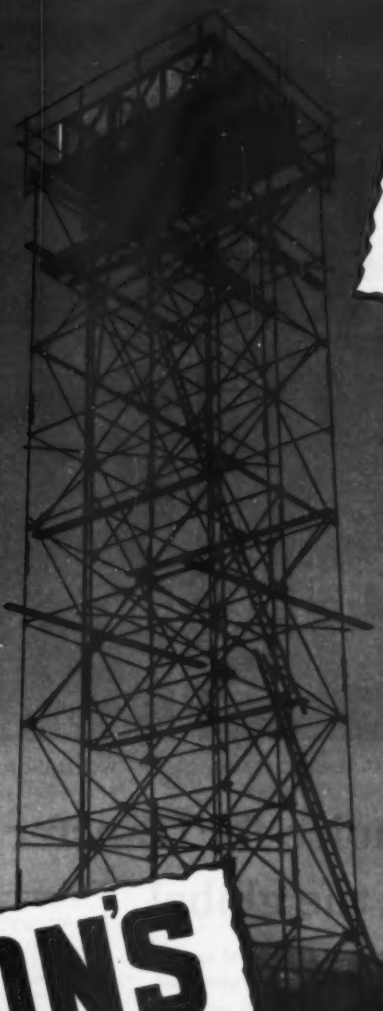

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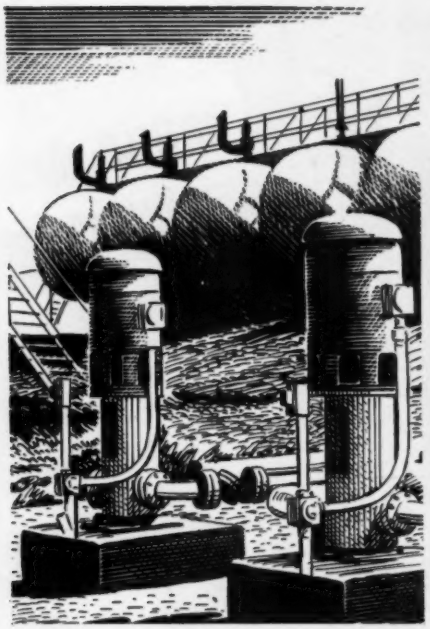

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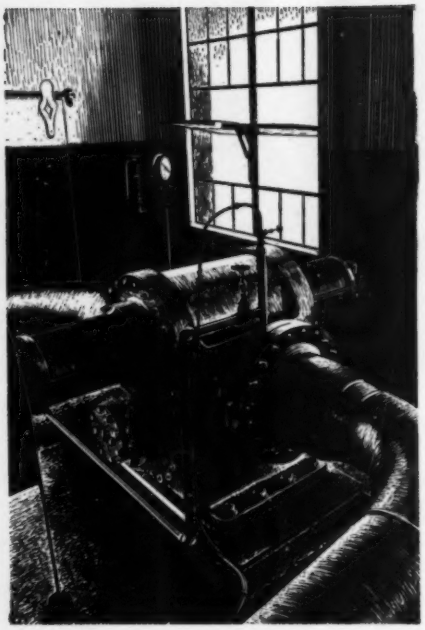

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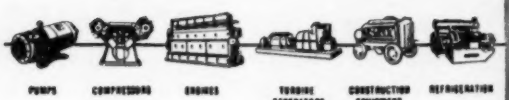

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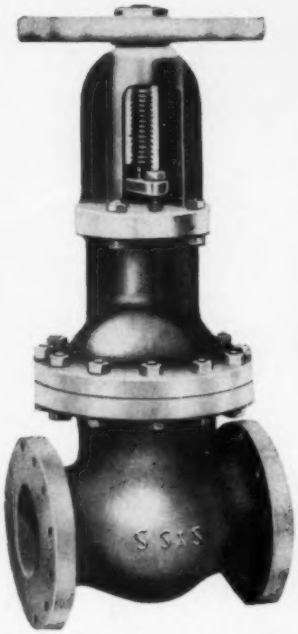

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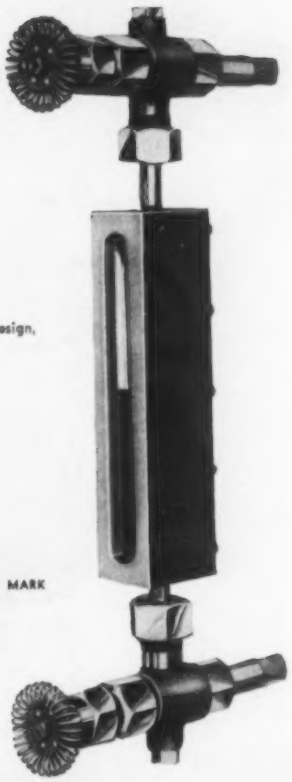

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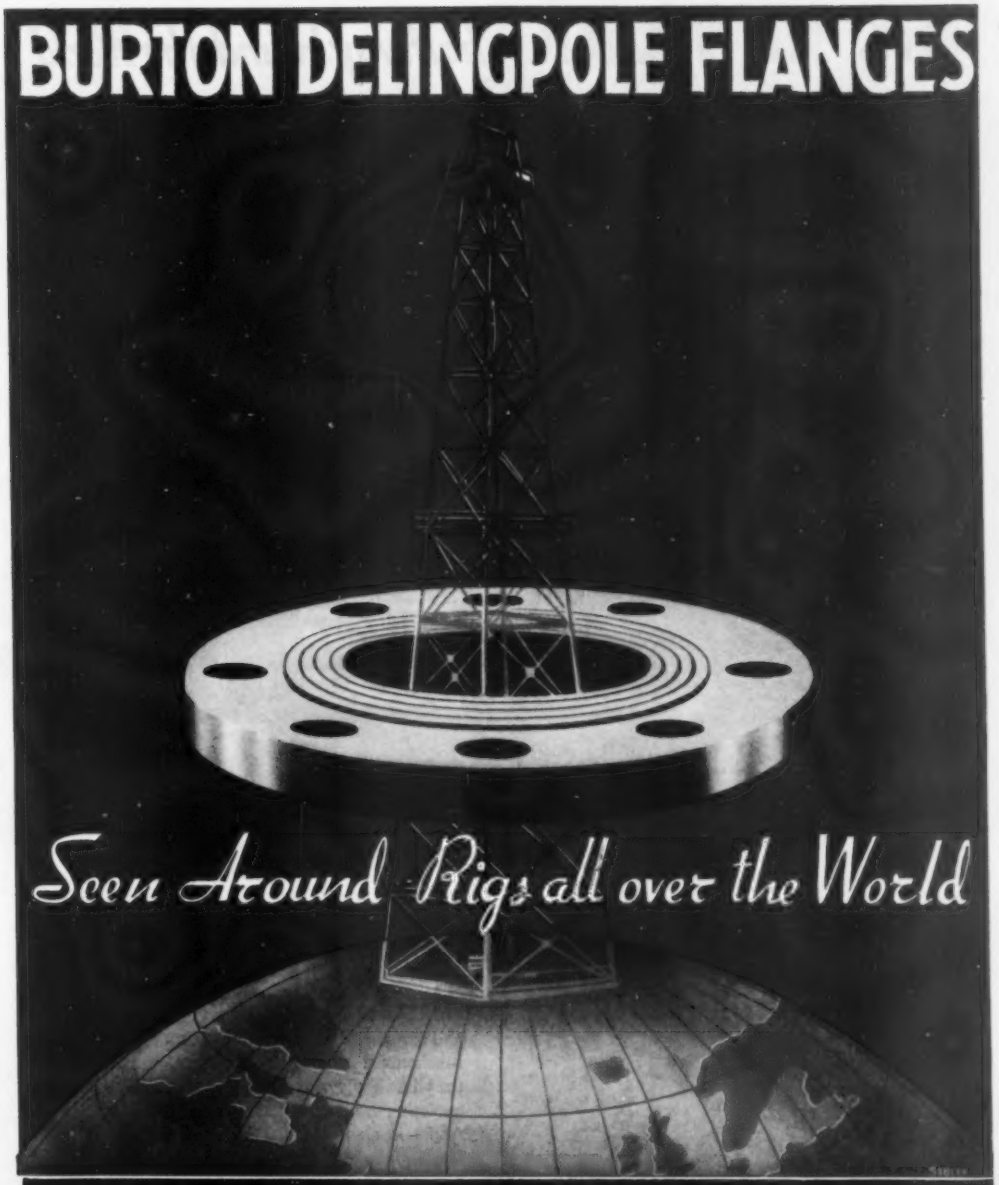

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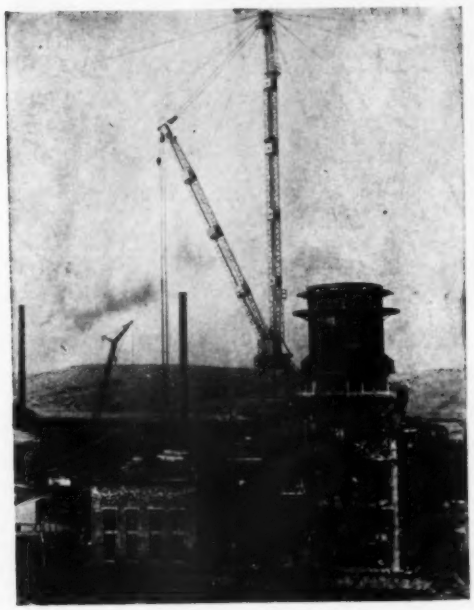
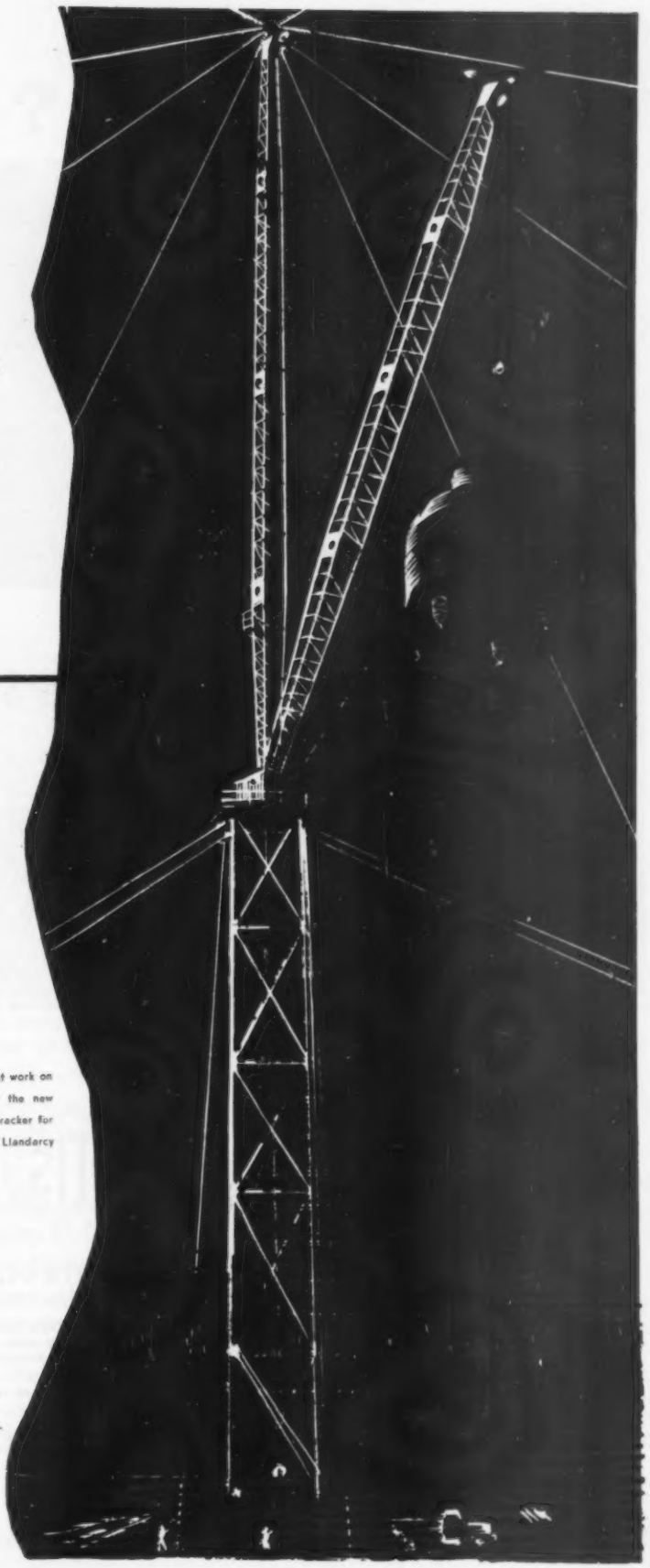


The crane at work on the site of the new Catalytic Cracker for A. I. O. C. Llandarcy project.



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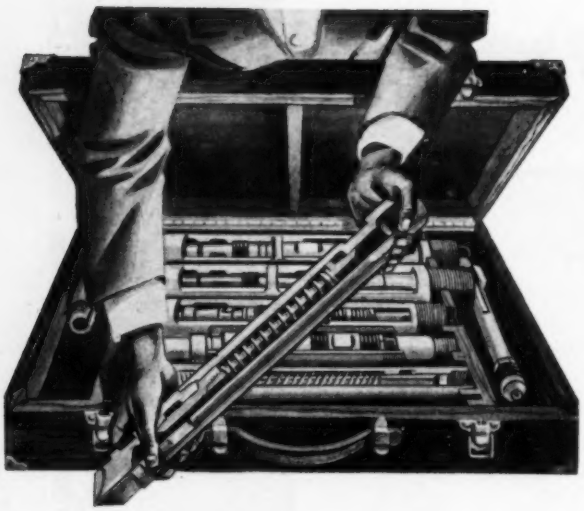

Man With the Show-How

Although most of our customers fully understand the *functions* of Otis Tubing Safety Valves, Bottom-Hole Chokes and Regulators, and the various Otis Locking Assemblies with which Otis sub-surface tools are landed, many operators are not acquainted with the *design* and *operation* of the equipment. This is understandable, because the critical parts of the average Otis sub-surface control are inside of the cage, mandrel, or nipple, and the fact that the tools are downwell equipment prevents actual observation, and further complicates demonstration of the working mechanisms. To overcome this minor adversity, Otis has several kits of quarter- and half-section cutaway models of actual tools which makes the design and operation of the equipment virtually self-explanatory. You can disassemble them, reset the valve springs, check the machining, measure the I.D. and O.D. clearances, inspect the packing . . . in fact do anything but set them in your oil well. If you would like to examine first-hand a set of Otis sub-surface controls — whether you are using Otis equipment or not — contact your nearest Otis office, or write on your firm's letterhead to Otis in Dallas. Our representative will gladly make arrangements to call on you, and afterwards you'll be better informed on better methods of producing your high-pressure wells. There is no obligation, of course.

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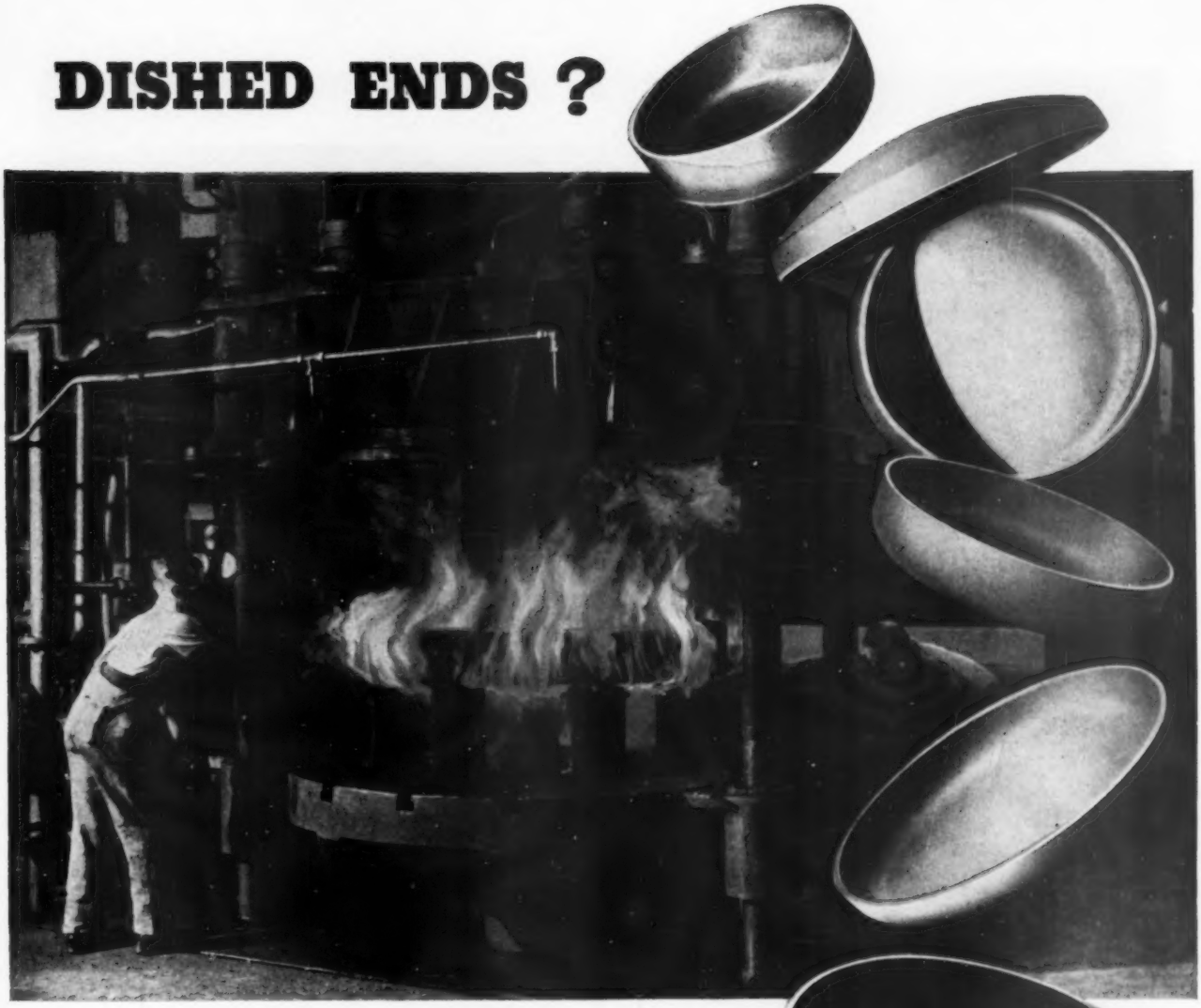

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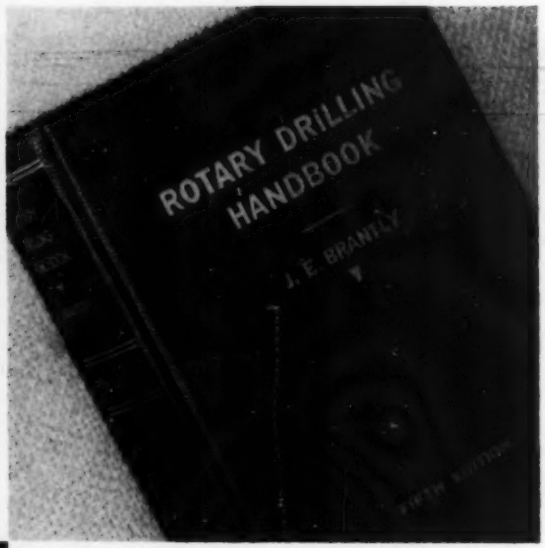

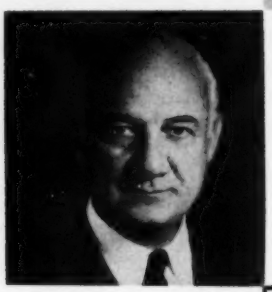

Discoveries and inventions, improved techniques and new equipment required a complete re-writing of this standard authoritative work. All tables, *filling 206 pages*, have been re-checked, revised, and expanded. New tables have been added.
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CONTENTS

CHAPTER		CHAPTER	
I	BASIC PRINCIPLES OF OIL WELL DRILLING	XVII	BALANCED ROTARY DRILLING
II	POWER PLANTS	XVIII	STRAIGHT HOLE DRILLING
III	CIRCULATING PUMPS	XIX	INSTRUMENTS
IV	DERRICKS AND MASTS	XX	DIRECTIONAL DRILLING
V	PRIME MOVERS AND HOISTS	XXI	FISHING
VI	ROTARY TABLE UNITS	XXII	CASING AND CEMENTING
VII	FIELD CONTROLS	XXIII	FORMATION TESTING
VIII	DERRICK EQUIPMENT	XXIV	HOLE SIZES AND WELL PROGRAMS
IX	LUBRICATION	XXV	SAFETY MEASURES
X	WIRE LINES	XXVI	GEOLOGY AND FORMATIONS
XI	DRILLING SHAFTS	XXVII	ACCOUNTING
XII	PIPE & DEPTH MEASUREMENTS	XXVIII	SUMMARY
XIII	BITS		
XIV	DRILLING FLUID		
XV	ROTATING SPEEDS		
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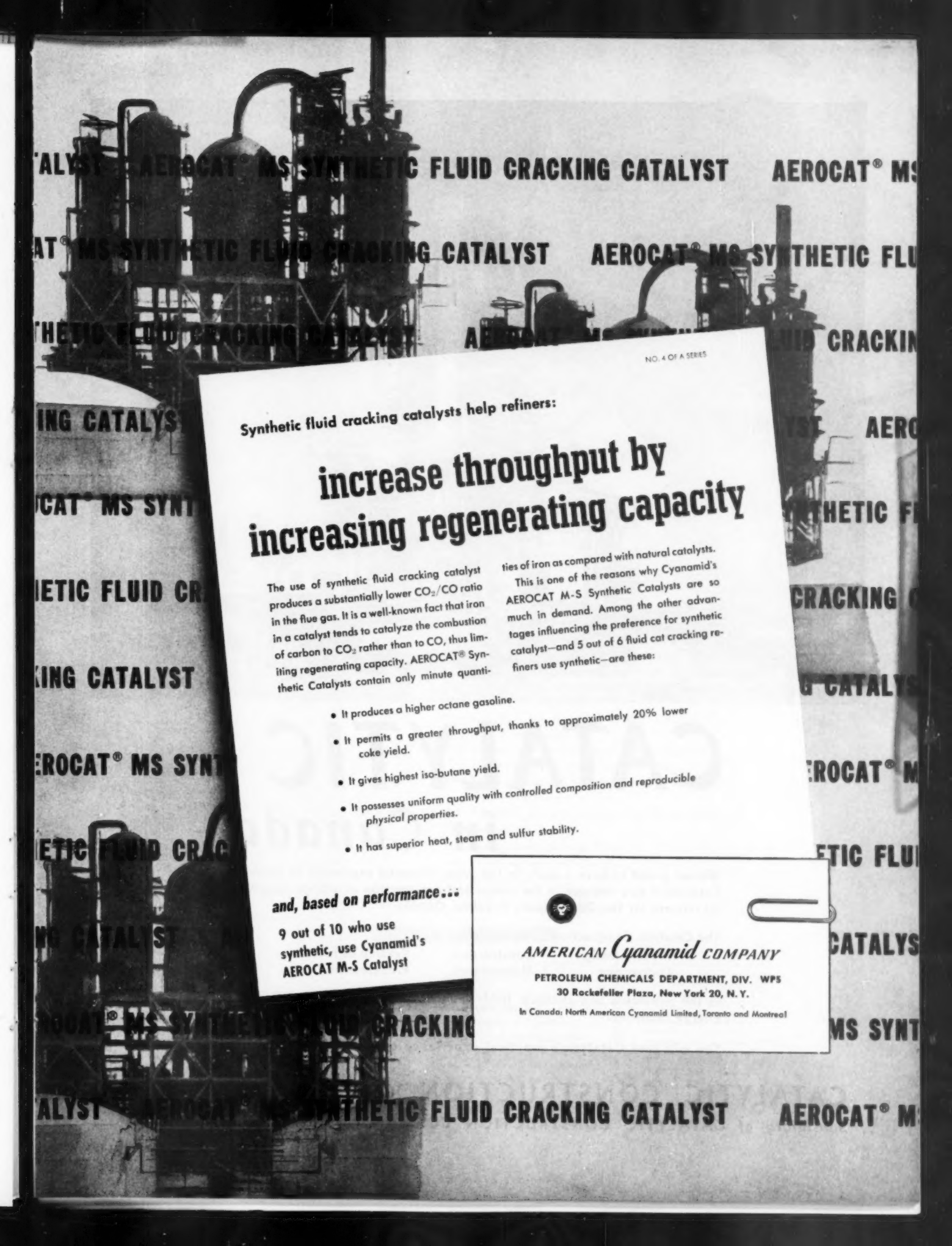

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MAY 1952

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CONTENTS

63 Five Years of Progress
64 Trans Mountain Pipe Line
67 Canadian Wildcats 25.9 Percent Successful in 1951
72 Petrochemistry in Canada
76 Canadian Oil Consumption Rose 14 Percent in 1951
78 Western Canada's Natural Gas
82 Canadian Oil Companies Refinery Begins Operations
88 Sub-Zero Weather Complicates Well Servicing Operations
90 Geophysical Activity in Western Canada
94 Jet Bit Drilling in the Leduc Field
100 Alberta Oil Operations Continue at Rising Tempo
104 Surveying Radioactivity Distribution as an Indication of Oil and Gas
106 Active Studies of Athabaska Oil Sands Undertaken by Seven Oil Companies
108 Canada is Spending $100 Million to Enlarge Pipe Line System
114 Some Aspects of Financing Western Canada's Petroleum and Natural Gas Industry
120 Saskatchewan Oil Search Spurred by Medium Oil Discovery
122 Canadian Refiners Increase Capacity at Rapid Rate
132 British Oil News
138 International News & Notes
146 Oil Company Staff Changes
172 Advertiser's Index

THIS MONTH'S COVER

The microphone of a seismographic recorder is set into the frozen ground for a test near Great Slave Lake, at the most northern point of Standard of California's exploration program. Photo by John Lyon, courtesy Standard Oil Company of California *Bulletin*.

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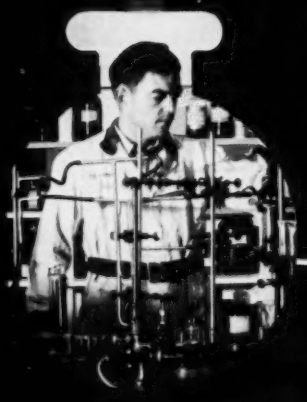

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FIVE YEARS OF PROGRESS

BY THE HON. GEORGE PRUDHAM

MINISTER OF MINES AND TECHNICAL SURVEYS, OTTAWA, CANADA

TO a country that had been dependent upon outside sources of supply for more than 90 percent of its crude oil requirements, the discovery of oil in the Leduc field in Alberta in February, 1947, and the succession of events that have followed can indeed be regarded as developments of the greatest significance and importance. Prior to the Leduc discovery, the outlook was far from bright. Production was dwindling steadily and interest in the search for oil was at a low ebb. Imports were rising to keep pace with a rapidly rising consumption.

In the five years that have since passed, the picture has changed almost beyond recognition. Canadian production of crude oil, more than 95 percent of it from Alberta, has increased sevenfold; known reserves in that province, now at 1.7 billion barrels, are close to 17 times greater than in 1947; and the flow of money into the various phases of oil exploration and development has now reached an estimated $250,000,000 a year, an amount twenty times greater than five years ago. A self-sufficiency in balance of crude oil for Canada, which was little more than a hope before the Leduc discovery, now appears to be within reach.

Meantime, the rapid expansion of the industry continues and the prospects for still greater expansion are bright. The whole prairie region is now self-sufficient in oil, and oil from Alberta is supplying a large share of Ontario's requirements. By the spring of 1954 it will be flowing to West Coast markets through a 693-mile pipeline now under construction from the Edmonton area to Vancouver.

And quite apart from the developments in connection with well petroleum is the increasing interest being shown in the huge oil sand deposits of northern Alberta. Intermittently during the past 40 years, engineers and scientists of the Federal Government have been conducting field and laboratory investigations to determine the nature, extent, and potentialities of the deposits and to devise economic methods of recovering the bitumen and of producing marketable products. This work, in conjunction with that of the Government of Alberta and of private companies and individuals, has reached a stage where the active development of the sands is now considered to be technically feasible.

Already these oil developments have greatly enhanced the Canadian economy, but in the light of present knowledge, Canada stands to reap much greater benefits in the future. The developments afford yet a further striking illustration of the rapid industrial growth of the country.

TRANS MOUNTAIN PIPE LINE

D. L. Roberts, vice president, Canadian Bechtel, Ltd.

CONSTRUCTION work has begun on the $80 million, 24-inch Trans Mountain pipe line which will deliver prairie province crude to the Pacific coast and thus create a third major outlet for western Canada oil. First outlet was the development of local refineries on the prairies which have now reached a capacity of 85,000 b/d. Second step was construction of the Interprovincial line which is being enlarged to deliver about 117,000 b/d of oil to tankers on the Great Lakes for delivery to Ontario refineries.

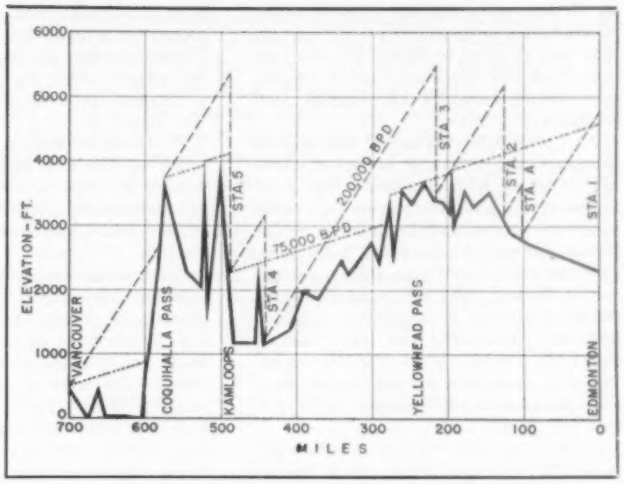
Initial pumping capacity of the Trans Mountain line will be 75,000 b/d, which is nearly three times the present 29,000-barrel refining capacity in the Vancouver area. Eventually the line could carry about 200,000 b/d. To reach such a capacity, it will be necessary to greatly expand the British Columbia refineries and to export crude to the state of Washington. In view of the rapidly expanding economy of the Pacific coast in both Canada and the United States, and the difficulty of finding new oil in California, it is anticipated that the industry will build enough new plants near Trans Mountain to run all or a major part of the crude which the pipe line can deliver.

Projected completion of the 700-mile line at its initial capacity with two pump stations is scheduled for late in 1953. Four additional stations will be required to bring the line up to 200,000 b/d.

The Trans Mountain line must traverse two mountain ranges before it can reach

Route of line through timber on the west side of Yellowhead pass.

Route of Trans Mountain line selected after surveying three possible routes across the mountains.



Profile of line with hydraulic gradients and pumping station locations for throughputs of 75,000 to 200,000 b/d.

Vancouver. Both are precipitous and offer few traversable passes.

The first step in selecting a route through the mountains was to examine topographical maps of a wide strip of country between Edmonton and the Pacific coast. This examination narrowed the selection to two routes; one through Crows Nest Pass to Spokane, Seattle and Vancouver; and the other over Yellowhead Pass directly to Vancouver. The next step consisted of a reconnaissance over these two routes by airplane, automobile and train in January 1951. This showed that the all-Canadian route was more economical, not only in cost, but in the tonnage of steel required.

The route is not only the shortest practicable distance between Edmonton and Vancouver (700 miles as against a crow-flight distance of 515 miles), but it also offers best conditions of elevation and accessibility. The Yellowhead Pass is at an elevation of only 3,720 feet, just 1,400 feet above Edmonton. The western slopes drop gradually to elevation 1,200 and then the route rises abruptly to elevation 4,000 on the plateau south of Kamloops, B. C. The crossing of the Coast Range at Coquihalla Pass is only at elevation 3,660.

The first 500 miles west of Edmonton, the route parallels the Canadian National Railways line to Kamloops. It then goes across country for 55 miles to the town of Merritt, where it meets a line of the Canadian Pacific Railway and follows that line for 67 miles to the upper end of the Fraser River Valley. The last 80 miles into Vancouver traverses a settled community with highways and secondary roads.

Beginning last June, aerial photographs were taken of the entire route. These pictures, at a scale of approximately 3,700 feet per inch, showed a strip of country five miles wide. Experienced technicians studied the pictures under stereoscope and plotted a location which was verified or altered in the field by six parties of engineers and construction men who walked the entire line, flagging the route. Survey parties followed these reconnaissance crews, staking the line and making the necessary land ties. Heavy snowfall and sub-zero weather throughout the interior of British Columbia hampered and at times temporarily stopped the work, but five parties persevered all during the winter months to prepare for construction this spring.

For 200 miles west of Edmonton and in the 80 miles east of Vancouver, the location presents only ordinary problems. The geological features of the route through more than 400 miles of mountainous topography in the central section indicate heavy glaciation which has resulted in a flat, relatively wide valley whose beds are mainly silt interspersed with boulders. The reconnaissance notes revealed less than 15 miles of solid rock exposed along the centerline of the route. At infrequent intervals and for distances which rarely exceed one-half mile, there are side encroachments of bedrock, cliffs and slopes. Most of the problems of location occur in these constricted sections, and then only because a river, a railroad and the site of a future highway have usurped the valley floor. Generally the solution has been to infringe on the railroad or highway right-of-way and work out details of design and construction mutually satisfactory to the pipe line company and the right-of-way owners.

As a point of interest, it has been possible to avoid most snow slide areas by crossing to the opposite side of the valley or by placing the pipe line in the bottom of the valley where the only effect of a slide is to pile more cover over the line.

Redwater crude was assumed as typical for design of the line. This is a 35° gravity crude with a viscosity of 115 SSU at 40° F. The average temperature of oil flowing through the line was assumed at 40° F. The theoretical friction losses calculated on these assumptions were later checked against actual experience factors derived from the first six months of operation of the Interprovincial pipe line, and were found to be conservative.

The line is tapered by reducing pipe wall thickness in 1/32 inch increments as pressures decrease away from the stations. Five sixteenths-inch wall thickness pipe has been set as a minimum in the mountains and ¼ inch on the prairies. At two locations on the line, special pressure-limiting stations are being designed to control the static head pressure resulting from shut-down of the line. One will be an automatic shutoff valve actuated by an increase in line pressure and the other will be a battery of relief valves draining the line into a storage tank.

High-Test line pipe is specified for the job. This is an electric fusion welded pipe with a high manganese content. One interesting feature in the manufacture of the pipe is that it has been found necessary to limit the upper value of transverse yield strength to 75,000 psi. Otherwise, special and costly welding techniques are required in the field. Another interesting feature is that the pipe is fabricated at less than nominal diameter and then placed in a confining cylinder

and hydraulically expanded to beyond its yield point. The maximum allowable working pressure used in design was based on 65 percent of nominal yield strength, which varies from 52,000 psi for ⅜ inch pipe and thinner, to 46,000 psi for pipe over 7/16 inch thickness, and a 10 percent minus tolerance on nominal wall thickness.

As protection against temperature changes, the line will be buried throughout its length with a normal cover of 30 inches over the top of the pipe. In rocky areas the cover will be reduced to 24 inches, and east of the Rocky Mountains, where severe winter temperatures are common, a 36-inch cover will be provided. Although corrosion is considered a minor problem, particularly on the western slopes, the line will be coated and wrapped. The only expansion provisions are slack loops placed in the line when it is lowered into the ditch.

Extra heavy pipe, ½ inch, will be used at all river crossings and it will be buried at a sufficient depth to protect the pipe against scour in the bottom of the river. Cast concrete weights bolted to the pipe overcome any buoyancy and tend to seat the pipe firmly in its trench. At major rivers, block valves will be placed on either side. Valves will also be placed in the line at approximate 20-mile intervals.

Some of the Alberta oils have a high wax content. During the winter months, it is anticipated that scrapers will have to be run through the line once a week. Traps to remove the accumulated wax and the scraper are to be built into the line at 125-mile intervals or at pumping-station locations.

Pump-station design is standard. The prime movers will be diesel engines operating on crude oil from the line. Centrifugal pumps, driven through speed increaser gears, will move the oil through the line.

Communications between terminals and pumping stations and along the line will probably be provided by a teletype circuit and a telephone circuit with frequent drops for field phones. Weather conditions in the mountains prohibit airplane patrols. Many miles will have to be patrolled in four-wheel-drive vehicles or on foot. A radio system is being considered, but it may prove impractical.

Trans Mountain Oil Pipe Line Co. plans to segregate the oils from the various Alberta fields into four groups for batching through the line. Two 150,000-barrel tanks for each group will be erected at the gathering tank farm near Edmonton and at the terminal tank farm near Vancouver—a total of 16 tanks with 2,400,000 barrel capacity.

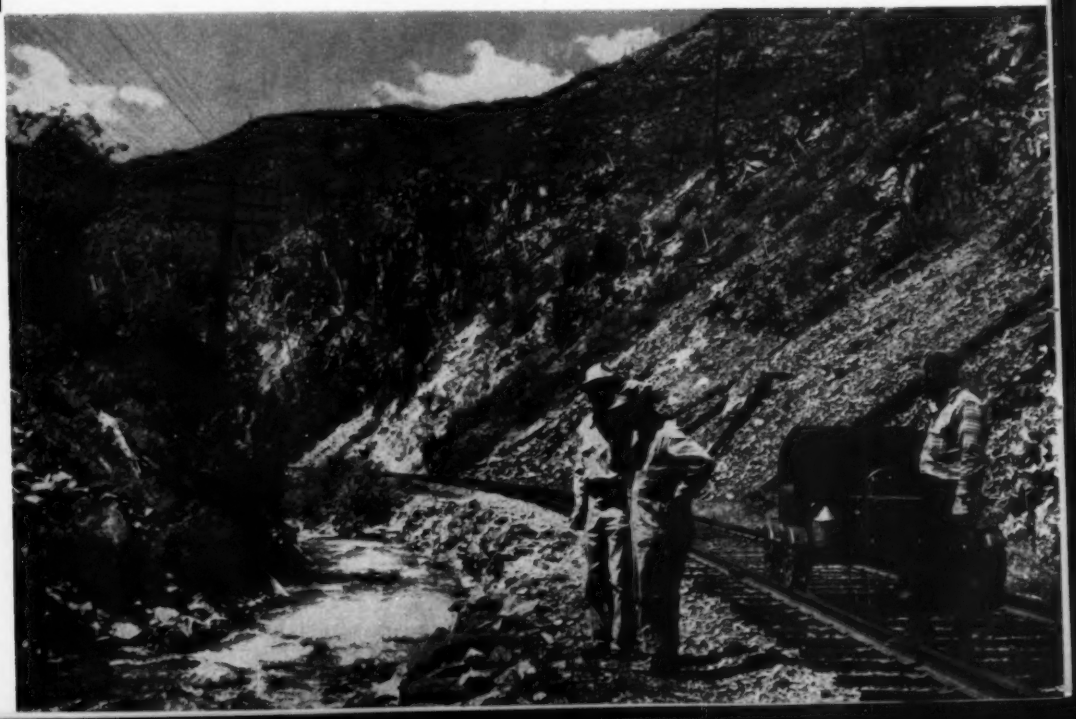
During construction it is planned to deliver all materials to sidings along the job site by rail. Access roads will be built from the sidings to the right-of-way and material will be hauled into position with light trucks and tractor-trailer units. Contractor's forces and inspectors will be housed in mobile trailer camps or in work trains, as there are no towns or cities along the line with accommodations for the 100 to 150 men required in each gang. Communications will be provided by teletype service and portable short-wave radio units.

The sections of the line constructed in 1952 will not be tested this year because of the danger that some water, not completely blown out or drained after testing, will collect in the low spots, freeze and possibly burst the pipe. It is planned to test the entire line immediately after it is completed, and just prior to filling it with oil for initial operations.

Data for the foregoing description of the Trans Mountain line was obtained largely from a paper by D. L. Roberts, vice president of Canadian Bechtel, Ltd., presented before the Seattle Spring meeting of the American Society of Mechanical Engineers. Photographs are reproduced through the courtesy of Richard Finnie, historian of Bechtel International Corp.

Motor road near Mount Fitzwilliam on the pipe line route.

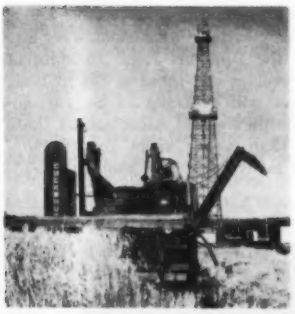
Narrow pases such as this one on the headwaters of the Coquihalla river present problems to the Trans Mountain builders.



> *"No one knows my country, neither the stranger nor its own sons. My country is hidden in the dark and teeming brain of youth upon the eve of its manhood. . . . Now must the heaving, fluid stuff of Canada take shape, crystallize and harden to a purpose. . . . Wondrous and very sweet is our name.* Canada! *The very word is like a boy's shout in the springtime, is like the clamor of geese going north and the roar of melting rivers and the murmur of early winds. . . . But we have not grasped it yet, the full substance of it, in our hands, nor glimpsed its size and shape. We have not felt the full pulse of its heart, the flex of its muscles, the pattern of its mind. For we are young, my brothers, and full of doubt, and we have listened too long to timid men. But now our time is come and we are ready."*
> "The Unknown Country-Canada and Her People," *by Bruce Hutchison.*

Canadian Wildcats 25.9 Percent Successful in 1951

BY RUTH SHELDON KNOWLES



The promising Wizard Lake discovery of McColl-Frontenac and The Texas Co. was made in a wheat farming area. Alberta Government photo.

CANADA'S OIL BOOM is just beginning! Although discoveries and development have had a remarkable rate of growth in the past five years, there is today an even more breathless quality of anticipation and a tenser excitement among the wildcatters and explorers. With more land under lease than ever before, more wildcats being drilled, more geophysical parties in the field and more development rigs at work, the atmosphere is charged with suspense. The big game hunt is at a feverish pitch.

The explorers themselves are just beginning to realize with amazement the tremendous oil and gas possibilities of this vast area. As awe-inspiring as the wild beauty and great sweeping distances of Western Canada are its potential underground riches.

Dreaming over the map of Alberta, Saskatchewan, Manitoba, Western and Northeastern British Columbia and the Northwest Territories, the explorers see a favorable geological area three times that of Texas, but whose proven reserves are as yet only one-tenth those of Texas. They are excited by the fact that there have been a higher proportion of large fields, over 50 million barrels, discovered in western Canada than in Texas. As each new wildcat is spudded in, they are stimulated by the knowledge that last year one out of every four wildcats hit.

"This is the most favorable oil and gas area in the world today," the exploration chief of one major oil company states. All agree that development is just beginning. In Alberta, which has seen the greatest concentration of exploration drilling to date, there has been only one wildcat drilled to every 82 square miles of potential oil territory.

In their haste to meet the great sprawling challenge of Western Canada, the wildcatters have taken such big jumps from one area to another, and exploration has of necessity been on such a broad, general scale, that the companies are haunted by the disturbing thought that they may have skipped over any number of Leducs or Redwaters. But relentness competition forces them ever northward into new areas. With the central Alberta plains area only barely touched, the land play has rushed into the remote and difficult Peace River area and on into the Northwest Territories. Half of the 155 geophysical parties in Western Canada are working north of Edmonton. As the drilling rigs follow, they reveal the vision of the oil seekers—for this is truly oil for the future.

The essence of the dream can only be captured by flying hundreds of miles in a ski plane over a white and silent wilderness, landing on a frozen lake to watch a northern wildcat drilling by its edge. It is inspiring to see the casual courage and matter-of-fact ingenuity with which men solve the cruel physical problems of searching for oil in 50 degrees below zero weather in almost inaccessible spots, far from supply bases.

Cutting a trail through the virgin muskeg with a "cat skinner" in the Peace River district. Imperial Oil Ltd. photo.

This brings a realization that there is another factor in the equation besides the existence of oil and the desire of men to find it. A favorable political climate has offset the unfavorable physical climate, for oil is not only where you find it, but where you are permitted to find it. The Western Canadian oil boom might still be a thing of the future if it had not been for the rising tide of nationalism in Central and South America during the past two decades and the present turbulent situation in the Middle East. Nationalism, not weather, freezes oil development.

The physical difficulties of oil-finding in Canada have melted into insignificance due to the warmth of the political welcome which the industry receives. Alberta Minister of Mines and Petroleum N. E. Tanner states, "This government has encouraged a free, competitive oil industry more than any other government in the world; and we will continue to, as only when a government does so, do you have oil development."

The truth of his words is brought into sharp focus even within the limits of Western Canada. Alberta has seen the greatest development so far, while neighboring Saskatchewan, whose provincial laws are more stringent, has seen relatively little. Saskatchewan has caught the point, and new oil and gas regulations have been drafted after discussion with industry representatives and are expected to be enacted this year. Increased exploration and wildcatting will be an immediate result, particularly in view of the successes in the Williston Basin south of the international boundary and recent hits both in Saskatchewan and Manitoba.

In the United States, as C. W. Tomlinson points out in an A.A.P.G. paper, *Freedom and Petroleum Geology*, "our growth in service has not been the result of central planning, but a tribute to the lack of it. It is the fruit of freedom." The fruit of freedom has ripened rapidly in Western Canada since the discovery of Leduc in 1947 dramatically reminded oil men that there was oil as well as gold in the Far North. The 166 million acres now under lease and reservation is eight times the amount in 1946. The $225 million spent last year in exploration and development is 19 times the amount spent five years ago. Reserves have increased thirty times and potential production eleven times.

Within the next four years, industry investment in exploration and development is expected to double, if not triple, that of the past five years and Canada will have reached self-sufficiency in oil production and will probably be in the position of a net exporter.

During 1951, exploratory drilling showed a 50 percent increase over 1950 with 485 exploratory tests being completed, of which 349 were dry, 59 were oil and condensate discoveries, and 77 were gas discoveries.

The majority of the exploration was in Alberta, which accounted for 412 of the tests, 55 of the new field wildcat oil wells, including three condensate wells, and 72 of the wildcat gas discoveries. Most of the new pools were extensions of the trend of prior discoveries. Wizard Lake and Bonnie Glen were important discoveries on the southern end of the Leduc reef trend. Southern extensions were also found to the Duhamel Reef. In spite of 1951 discoveries and those so far in 1952, exploration will continue to be particularly active in Central Alberta, and there is more than ample room for the discovery of many more reef pools.

George Brown, former Royal Canadian Air Force pilot, is now doing bush flying for Socony-Vacuum Oil Co. in Alberta. He is shown checking emergency plane equipment. Socony-Vacuum photo.

A new type motor-driven toboggan which Socony-Vacuum Oil Co. is considering using in its field operations in Canada. The sled will attain a speed of 40 mph in snow. Socony photo.

Gas discoveries in Alberta outnumbered oil discoveries, and increased wildcatting in the foothills area, where the largest proven gas reserves exist, was anticipated if the Alberta government favored gas export. However, the Alberta Conservation Board, in its long awaited March report, recommended that all gas south of Edmonton be held in reserve to meet Alberta's projected needs over a 30-year period. It considered the only exportable surplus to be in the Peace River area, and the estimated surplus of 300 billion cubic feet would not appear to be sufficient to warrant a pipeline to the Pacific Northwest. The board stated that on the basis of 400 to 500 wildcats a year, gas reserves would probably increase at the rate of a trillion cubic feet a year for at least eight to ten years. However, it did not use this fact in determining any exportable surplus. This may well prove a boomerang if the policy is adopted by the government, for the lack of an export market from southern Alberta will depress rather than stimulate wildcatting in this area.

Gas, as well as oil, is not a prisoner of the earth's rocks, but of the laws men make. The philosophy of competitive freedom which the Alberta government has embraced is strongly challenged by this problem of gas export. Gas development as well as oil development depends upon the stimulus of freedom as opposed to the throttling of government planning. Reserves are maintained and increased only by continuous wildcatting, which in turn results only from the availability of markets.

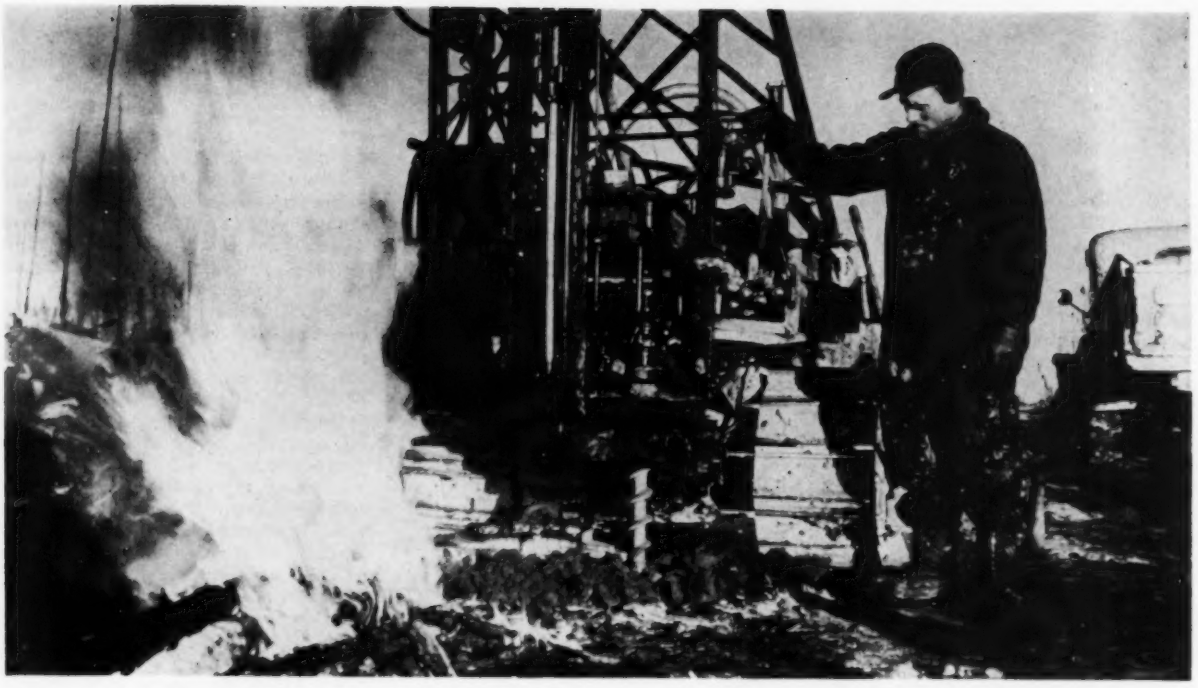
Much gas is discovered incidental to the search for oil, but this now being a gas as well as an oil age, the wildcatters seek favorable gas areas, such as the foothills area, for gas itself. They will look twice, however, at their risk investment in view of the case of Pincher Creek. This largest known gas reserve in Alberta, containing an estimated 1,680 billion cubic feet of disposable gas, was discovered in 1947. Four wells, costing approximately a million dollars each, have been drilled and four more are being drilled this year. Canadian Gulf, owners of the pool, had planned a development program involving the expenditure of $365 million. For every dollar's worth of dry gas produced, $1.65 worth of by-products such as propane and sulfur would be produced.

The Conservation Board's recommendation that Pincher Creek not be put into production until 1968, if accepted by the government, halts this development program, and could mean that it would be 21 years from the time of the company's discovery well before it could start to receive any revenues from its investment. Wildcatting capital is not attracted by such situations. The public interest, which is advanced as the reason for such arbitrary planning, suffers from the delay of allied agricultural and industrial development and the retarding of new discoveries since no government has yet found out how to legislate abundance into existence.

Whether or not Alberta is to continue to warrant its reputation as one of the last strongholds of competitive free enterprise depends in great part upon its final solution of the gas export problem.

The Alberta Conservation Board's recommendation that Alberta's Peace River area contained an exportable surplus of gas was of significance in the British Columbia picture. British Columbia's only discoveries of importance in 1951 and so far in 1952 have been a total of four gas wells in the Ft. St. John area, which is

Unwinding geophone cable in the north country. Imperial Oil Ltd. photo.



Fire near shothole drilling rig helps keeps the auger-type machine operating smoothly in sub-zero weather. Imperial Oil Ltd. photo.

part of the general Peace River area. These discoveries by Pacific Petroleums have stimulated exploration and wildcatting. There are some 25 million acres under lease in northeastern British Columbia, held by 48 companies. Since British Columbia permits half of exploration expenditures to be applied against rentals, considerable activity can be expected in this area during the next few years.

In Saskatchewan, wildcatting in 1951 and early 1952 found four new oil fields and three gas fields. The line of new pools in Alberta running northwest and southeast from Lloydminster continues in Saskatchewan. They are mainly in the Lower Cretaceous, with heavy oil content, but the new Fosterton field in Saskatchewan produces light oil from a basal Lower Cretaceous sand.

Manitoba had ten exploratory wells drilled in 1951, of which nine were dry and one found oil. California Standard produced about 5,000 barrels from the Virden field in September and October, which reservoir is Mississippian in age. After lengthy production tests these wells were suspended, however.

The main producing horizons in Western Canada continue to be the Leduc (D3) Devonian and the Nisku (D2) Devonian. Although Lloydminster's heavy oil has been considered characteristic of the Lower Cretaceous, there is an increasing number of lighter oil discoveries from this horizon. The Viking sand emerged also in 1951 as a more important reservoir for light oil. Shows of oil have been found in horizons deeper than the D3 reef, but nothing of commercial significance has yet been recorded.

The exploratory well failures which reached the basement did not elate the companies, but each basement test delighted the geologists because of the new information revealed. The Peace River Pre-Cambrian high forms a dividing ridge between the Alberta and Peace River Devonian basins. Basement tests in 1951, although commercial failures, helped define this feature more closely.

The basement is being increasing recognized as a controlling factor in these Devonian basins. "A geologist can be no better than the information he can get from the bottom of the hole," says one geologist, who plugs for basement tests in practically every case.

Reflection seismograph continued to be the most popular geophysical method, with particular success in defining structure being reported by operators in the Peace River area.

Imperial's new wildcat now drilling in Alberta just three miles south of the Northwest Territories line casts the shadow of coming events. The great solid blocks of leases in the north will hasten wildcatting. The operating head of one major oil company predicts, however, that the 166 million acres now under lease have reached a peak in volume. They will change hands many times, but the great land play has now peaked, in his belief.

Every plane into Calgary brings at least one southwestern independent oil operator (usually from Texas) eager to find out how he can participate in the Canadian boom. His appetite is more than whetted by the obvious great potentialities, but he is generally baffled by how to go about this business of Canadian wildcatting. In Alberta, where the best opportunities lie, the majority of land is under lease and acreage prices are high. There is almost more money than oil deals available—and with the greener-pastures philosophy which is so typical of the oil industry, everybody is taking farmouts from everybody else. Major companies even take farmouts from independents!

Wildcatting ventures are usually joint, with several companies participating. The phenomenon of the Canadian "penny" stock exchange continues to flourish, making capital the least of a small company's worries. This version of a national lottery is probably unhealthy for the industry from a long range point of view, for when the boom subsides, there will undoubtedly be a great "wailing and gnashing of teeth" as a lot of people find they have lost a lot of money.

The fact that the Alberta government owns approximately 90 percent of the mineral rights in the Province poses a difficult public relations problem for the companies. Although the surface owners are paid liberally for land damage and

land use, there is still a certain amount of resentment among those who do not own the mineral rights when they see or hear of the benefits received by those who do. Neither the government nor the companies believe, however, that the problem is a pressing one at this time and there is no movement to make it one.

The sale of Crown Reservations in 1951 gave the Alberta government $14,798,952.76, bringing the cumulative total to $73,144,238.39. Including fees, rentals, royalties and licenses, the government has realized to date more than $110 million from oil development. Government policy concerning this income is unique, not as a philosophy, but for the fact that it is actually being put into effect.

"Our oil resources are a capital asset, since they can be depleted," states Minister of Mines and Petroleum Tanner. "We are going to expend these funds as you spend capital. We are going to convert them into capital assets—roads, public works, educational buildings, debt reduction of capital asset expenditures, and all those things that government ordinarily borrows money to do. We have $72 million in the kitty now for that. If current revenues aren't enough to take care of current expenditures, then what would be the future of the country?"

The government has already started to reduce its debt and anticipates that it won't be too long before Alberta is debt free. Of major significance is the fact that this policy was initiated before the oil boom began. A great many nations could well afford to study and copy Alberta administratively.

There is a deep emotional thrill to wildcatting for everyone who participates in it. The very word is a tonic and a simile for adventure and excitement. But in no other place in the world today is the activity itself more stimulating than in Western Canada. Here there is no contrast between the old and the new. Here there are no anachronisms, for everything is new! The wildcatters are pioneering in a pioneer country where the flame has just been lit under the melting pot. Everyone is from someplace else and everyone is pioneering. Here there is the hospitality which is the trademark of new frontiers. Here there is the excitement and vigor of great things to be done—of beginnings, not endings.

Canada's time has come. It is ready, and the wildcatter is helping to make "the heaving fluid stuff of Canada take shape, crystallize and harden to a purpose."

COMPARISON OF 1950 AND 1951 WILDCATTING RESULTS

YEAR		COMPLETED DISCOVERIES TOTAL	GAS	OIL	RATE GAS	RATE OIL	COMPLETED WILDCATS TOTAL	RATE GAS	RATE OIL	% TOTAL
1951										
	Alberta	84 (a)	55	29	65%	35%	280	19.64%	10.36%	30.0%
	Saskatchewan ..	5 (b)	3	2	60%	40%	51	5.88%	3.92%	9.8%
	British Columbia	1	1	nil	100%	—	12	8.30%	——	8.3%
	Manitoba	1	nil	1	—	100%	8	——	12.50%	12.5%
	Western Canada	91 (c)	59	32	65%	35%	351	16.8%	9.1%	25.9%
1950										
	Alberta	32	18	14	56%	44%	238	7.56%	5.88%	13.4%
	Saskatchewan ..	1	nil	1	—	100%	38	——	2.63%	2.6%
	British Columbia	nil	nil	nil	—	—	7	——	——	——
	Manitoba	nil	nil	nil	—	—	6	——	——	——
	Western Canada	33	18	15	55%	45%	289	6.23%	5.19%	11.4%

(a) includes 7 abandoned gas discovery wells. (b) includes 1 abandoned gas and 1 abandoned oil discovery well. (c) includes dual oil and gas discoveries in total of 64 completed discovery wells.

FIRST QUARTER 1952 CANADIAN DISCOVERIES

ALBERTA

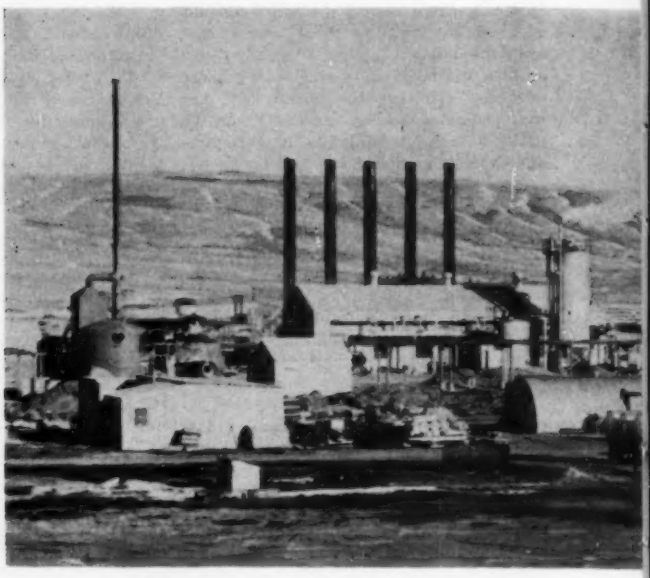
COMPANY	WELL & LOCATION	FORMATION & INTERVAL	IP OR TEST
Anglo-Canadian-Socony Vacuum	Twining 1 8-9-31-24-W4	Devonian Cooking Lake 7408-7482	65 BOPD (swabbed) 39° API
Canadian Delhi-Britalta	Winchell Coulee 1 10-24-29-6-W5	Cardium 5236-5246	3000 MCFGPD and condensate
British American-Cities Service	Hackett 1 13-15-36-18-W4	Blairmore 3809-3882	40,000 MCFGPD (est. open flow)
Canadian Gulf	Lampert 4 4-32-38-22-W4	Devonian D-2 and D-3 5540-87 and 5592-5660	12,000 MCFGPD and oil flow 37° API
Placid Oils	Lake St. Ann 1 15-16-55-2-W5	Devonian D-1 4550-4601	Pumped oil 20° API
Scurry Explorers	New Norway 1 16-10-44-22-W4	Devonian D-2 and D-3 5085-5107 and 5250-5310	3528 BOPD (D-3) 37° API
Canadian Gulf	C.P.R. Anderson 6 6-27-37-20-W4	Devonian D-3 5405-5411	189 BOPD (swabbed) B.S.&W. 40%
High Crest et al	New Norway 1 16-23-44-22-W4	Devonian D-2	Oil in test
Bay Petroleums	Hanna 4-1 4-1-31-16-W4	Viking 3375-3473	3,500 MCFGPD
Hudson Bay-Union	Dunvegan 1 6-4-81-6-6	Cadomin 3275-3300	7,100 MCFPD show of heavy oil
Hudson Bay-Union-Royalite	Chinook 1 16-24-85-24-5	Triassic ? 2687-2720	1100 M 1 bbl. 25° API oil

SASKATCHEWAN

Socony Vacuum-Western Prairie	Fosterton 1 2-10-17-18-W3	Blairmore 3065-3125	298 BOPD 1/4 choke 24° API
Sohio	Elrose 1 14-12-26-16-W3	Viking 2051-2068	8,000 MCFGPD
Canada Southern-Albercan	Driver 4 SW 29-31-24-W3	Viking 2251-2267	33-gravity oil to surface

BRITISH COLUMBIA

Pacific Pete-Allied Oils et al	Ft. St. John 4 14-21-83-18-W6	Triassic 4761-4805	9,000 MCFGPD and condensate



PETROCHEMISTRY IN CANADA

A LARGE scale petrochemical industry is being developed in Canada along with the expansion of natural gas and crude production and refining capacity. Projects recently announced for early completion will cost many millions of dollars. Plants will be erected on the prairies, in Ontario, and in Quebec.

Heretofore, petrochemical activity in Canada has centered in the Sarnia area where the government built a synthetic rubber plant during World War II and where Dow Chemical Co. has been processing light hydrocarbons from the Imperial Oil Ltd. refinery at Sarnia to produce styrene and ethylene glycol. Operations are to be enlarged in this area in line with the current increase in refinery capacity. Polymer Corp. is spending $9 million to increase synthetic rubber capacity by about 25 percent. In addition, very large installations are to be made in connection with refineries at Montreal and plants based on natural gas are to be erected in Alberta to recover sulfur and manufacture natural gas oxidation products.

The three petrochemical plants being built at Quebec will represent an investment of about $17 million and will produce about 41 million pounds of chemicals per year.

Shell Oil Co. of Canada, Ltd., is erecting a $3 million plant at its Montreal works for the production of isopropyl alcohol and acetone. Refinery still gases will be processed. The plant will be ready for operation in the latter half of 1952.

British American Oil Co. and Shawinigan Chemicals Ltd. have teamed up to organize B. A. — Shawinigan Ltd. which is building a $4 million plant for the production of phenol and acetone. British American has facilities installed for the production of cumene which stem from the World War II aviation program. Benzene will be brought in and the finished cumene prepared for pumping to the adjacent chemical plant where the Hercules process will be employed to oxidize the cumene and separate the two end products. Anticipated production is 13 million pounds of phenol and eight million pounds of acetone per year.

The process to be used by the B A.— Shawinigan venture for phenol and acetone is relatively new, although several plants are now being built in the United States to operate on this principle. Conversion of benzene into phenol by conventional means employs either sulfur or chlorine, both of which are in short supply at present. The new process does not use either and also produces acetone as a saleable by-product.

In this method, benzene is alkylated by refinery propylene to isopropyl benzene or cumene. Cumene is oxidized to hydroperoxide in an inert solvent such as xylene or toluene. The hydroperoxide is decomposed by boiling under pressure in the presence of a dehydrating agent, yielding phenol and acetone. Phenol is in great demand at present for the manufacture of resins of various types.

Shawinigan is one of the large chemical producers of Canada with a very large production of acetylene derivatives including aldehydes, acetates and polyvinyls. The phenol and additional acetone will help round out its position in the plastics industry.

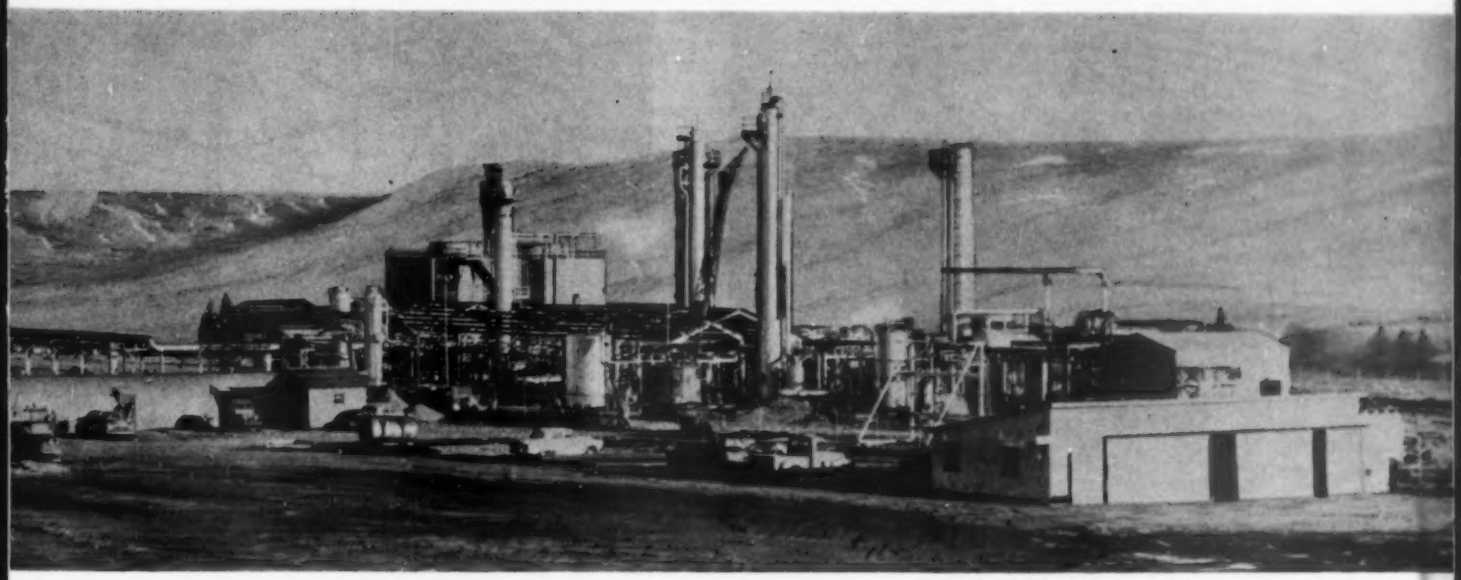
The Montreal plant involving the largest investment is the $10 million installation of Dominion Tar and Chemical Co. to produce ethylene glycol and ethylene oxide from refinery still gas.

Ethylene glycol is made from ethylene through the reaction of ethylene chlorohydrin to ethylene oxide to ethylene glycol. Its main use is for permanent antifreeze, but many lacquer solvents and new non-ionic detergents are based upon it.

McColl-Frontenac will pump a mixed stream of refinery tail gases to Dominion Tar. After separation of C_2 hydrocarbons, the C_3 and C_4 fractions will be returned for use by McColl-Frontenac as blending stock and LPGas. This plant will not be completed until 1953.

Also in Montreal will be Shell's plant for the manufacture of 20 million pounds per year of isopropyl alcohol and acetone, the first Canadian production of these products. In the Shell process, propylene is absorbed in sulfuric acid to give propylene acid sulfate which yields crude isopropyl alcohol on hydrolysis. By a series of distillations, substantially anhydrous isopropyl alcohol is produced. By dehydrogenation of the crude isopropyl alcohol and refractionation, acetone is made and hydrogen of exceptionally high purity formed as a by-product.

First major chemical plant in the prairie provinces based on natural gas was built in 1941 by Consolidated Mining and Smelting Co. of Canada, Ltd. This plant consumes about 10 million feet of natural gas daily to produce about 200 tons of



Shell's natural gasoline and sulfur plant in the Jumping Pound field.

ammonia and ammonium nitrate. Built as a war project for explosives, it has continued since the close of the war as a fertilizer factory.

Consideration is being given to the construction of another ammonia plant in Alberta for the production of ammonium sulfate as fertilizer. Natural gas would be used as raw material. The entire project is being considered by Sterritt Gordon Mines, Ltd. as part of a new plant for the recovery of nickel from nickel sulfide ores, the fertilizer being in effect a by-product of the metal plant which will cost about $17 million.

Celanese interests have undertaken a $90 million chemical plant construction program in western Canada which is partly based on natural gas and partly on wood pulp.

Approximately $54 million is earmarked for investment in the Edmonton area by Canadian Chemicals Co. for the production of solvents and acetate rayon from natural gas.

Ethane from natural gas will be cracked to ethylene. Polymerization takes place at pressures higher than in any other process known in commercial operation in the world, about 20,000 psi, and at temperatures ranging from about 400 to 1,200°F. To avoid explosion, the product must be removed continuously from the reactor and all operations are carried out by remote control.

C.C.L. will begin the first Canadian manufacture of polyethylene flake which has electrical properties which render it especially suitable for electrical insulation, e. g. in underwater telephone cables. It is also well-known now as a rival to cellophane in food wrappers and for lightweight raincoats. Other C.C.L. products will include methylal, dipropylene glycol, propionaldehyde, normal propanol, isobutanol, mixed butanols, methanol, acetone, acetaldehyde, propylene glycol, propylene oxide, acetic acid, formaldehyde, paraformaldehyde, and special solvents.

There is a shortage of sulfur in Canada for newsprint and chemical manufacturing and the oil industry is taking steps to alleviate the situation through the recovery of elemental sulfur from sour gas. Shell Oil Co. has built the first plant in the Jumping Pound field and Royalite Oil Co. has a plant near completion in Turner Valley. Each plant will produce about 10,000 long tons of sulfur yearly.

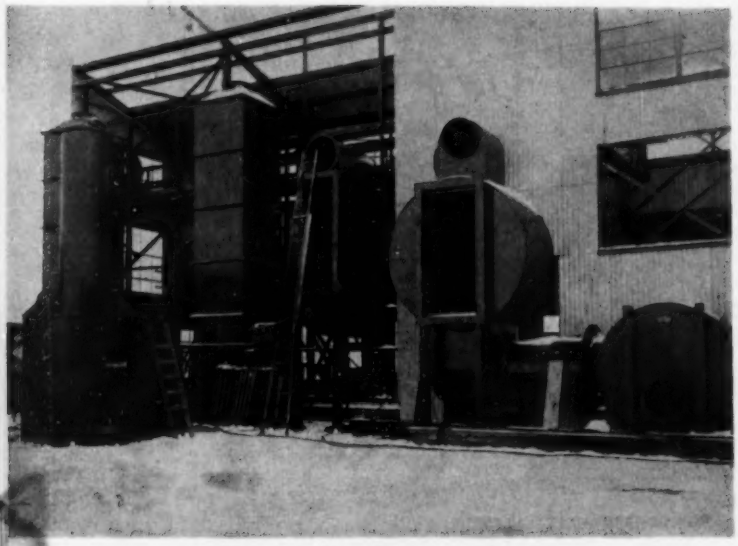
Shell Oil of Canada's new plant for the recovery of elemental sulfur from hydrogen sulfide commenced operation during February, 1952. It is the first of its kind to be built in Canada. It is now producing approximately 32 long tons of sufur per day with a conversion efficiency approaching 90 percent. The sulfur plant is located in Jumping Pound field, 35 miles west of Calgary, Alberta, and is associated with gas treating and dehydrating facilities and a gasoline plant.

Sour gas from the Jumping Pound field is first processed in the gas treating plant which operates with a conventional cycle utilizing a solution containing monoethanolamine, diethylene glycol and water. Natural gas containing six percent carbon dioxide and 3.5 percent hydrogen sulfide is purified in the treating unit at 830 pounds pressure to a purity of less than 0.25 grain hydrogen sulfide per 100 SCF and negligible carbon dioxide.

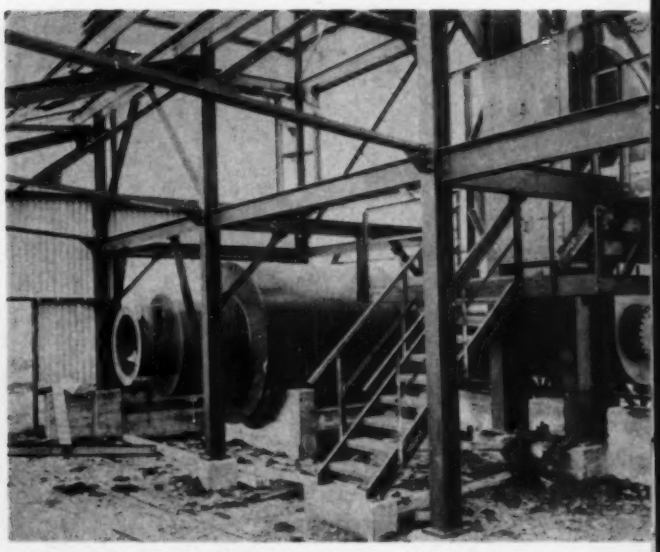
The purified gas is subsequently processed for the recovery of gasoline and is dehydrated in a dry bed type of dehydration plant. The gas processing plant, which was designed and constructed by the Fluor Corporation Ltd. of Los Angeles, has been in operation since April, 1951 and supplies purified and dehydrated sales gas for the city of Calgary.

Hydrogen sulfide and carbon dioxide absorbed in the contactor of the treating unit are stripped from the solution in a conventional stripping column. After passing through a cooler-condenser, this gas constitutes the feed for the elemental sulfur recovery plant. It is available at approximately 110°F. and averages about 34 percent hydrogen sulfide, 56 percent carbon dioxide, 9.5 percent water vapor and 0.5 percent hydrocarbons. As the presence of excess hydrocarbon in the feed to the sulfur plant is detrimental to its operation, the hydrocarbon content of the acid gas stream is maintained at a low level. This is accomplished by flashing dissolved hydrocarbons from the rich amine solution before it enters the stripping column.

A simplified flow diagram of the sulfur plant is given. Acid gas from the reactivator of the gas treating plant, after condensation of excess water, is fed directly into a specially designed reactor furnace which operates under sufficient pressure to drive the gases through the sulfur plant. Air is supplied to this unit by a steam turbine driven blower. Sufficient air is admitted to convert one-third of the total hydrogen sulfide to sulfur dioxide



North wall of Royalite sulfur plant during construction. Units from right to left, in direction of flow, are: reactor furnace, waste heat boiler, No. 1 economizer, No. 1 wash tower, and gas reheater in the left foreground partially concealing the No. 2 wash tower.



Interior view of Royalite sulfur plant during course of construction showing reactor furnace at left and portion of waste heat boiler.

and water, and all of the hydrocarbons entering the furnace to carbon dioxide and water. The principal reaction occurring in this unit may be written as follows: $H_2S + 3/2\ O_2 = SO_2 + H_2O$.

This reaction and the hydrocarbon combustion reactions are highly exothermic, and a temperature of approximately 1,600°F. is attained by the gas leaving the furnace. During normal operation, the entire acid gas stream is fed to the furnace and a small amount of sulfur is formed therein. The production of sulfur may be assumed to result from the following reaction: $2\ H_2S + SO_2 = 3S + 2\ H_2O$ although in actual practice the chemical path may not be so simple.

Combustion gases from the furnace are cooled in the waste heat boiler to a suitable temperature for catalytic conversion. From the boiler, which generates approximately 7,000 pounds per hour of steam, the cooled gases enter the first stage of catalytic conversion. In this state an appreciable portion of the elemental sulfur is produced and, in addition, undesirable side reaction products are eliminated. As the reaction of hydrogen sulfide and sulfur dioxide to form elemental sulfur is exothermic, the gas increases in temperature while passing through the catalyst. A second cooling step is therefore required to enable the final catalyst stage to operate at a satisfactorily low temperature. This is accomplished in a boiler feed water economizer so that the heat content of the gases can be recovered economically. The cooled gases are then passed through the second catalyst bed which operates at approximately 500°F. At this temperature, a maximum sulfur conversion is obtained without the deposition of liquid sulfur on the catalyst.

Sulfur containing gas from the second catalyst bed enters the bottom of a wash tower in which it is contacted countercurrently with cooled liquid sulfur.

The sulfur which is recycled to the top of the tower serves to cool the gases and efficiently collect the condensed product sulfur. Tower exit gas, which consists primarily of nitrogen, carbon dioxide and water vapor, is vented to the atmosphere, and the product sulfur which accumulates in the wash tower overflows by gravity to a sulfur run-down pit where it is maintained in a molten condition by steam coils. Sulfur is periodically pumped from this pit to storage vats where it is allowed to solidify by atmospheric cooling.

The plant is designed for simplicity of operation and extreme flexibility by the use of adequate instrumentation and strategically located bypasses. Essentially automatic control of the unit is attained with a flow ratio controller which maintains the proper ratio of air to acid gas and automatically varies the air rate to compensate for variations in the quantity of acid gas fed to the plant. This is supplemented by periodic analyses of the exit gas to insure that the correct ratio of air to gas is being maintained.

Three bypasses have been installed to permit the maintenance of optimum operating conditions with varying feed gas composition and quantity. A bypass around the reactor furnace and waste heat boiler permits hydrogen sulfide to be admitted directly to the feed to the first catalyst bed. This can be used to reduce the quantity of gas flowing through the furnace and boiler and permit the portion which does not pass through these vessels to undergo more complete combustion. In this way a higher temperature feed for the waste heat boiler can be obtained.

A second bypass is located on the furnace exit gas line so that a portion of the high temperature furnace exit gas can be made to bypass the waste heat boiler, permitting precise control of the gas temperature to the primary converter. A third bypass is provided in the gas stream across the feed water economizer. As this heat exchanger has sufficient surface to take care of the maxiumum plant load, the bypass is normally held partially opened in order that the optimum feed temperature for the second catalyst bed can be maintained.

Primary duties of the operator are maintaining proper boiler operation, lubricating the air blower and sulfur pumps, watching for any irregularities in plant performance, and running routine analyses on the tail gas to maintain the optimum hydrogen sulfide to sulfur dioxide ratio. Theoretically, the hydrogen sulfide and sulfur dioxide should be present in the gas stream leaving the last converter in the ratio of two moles of hydrogen sulfide per mole of sulfur dioxide to obtain the optimum yield of sulfur. The analysis used for control is a modification of the Tutweiler procedure in which an initial titration of the gas with standard iodine solution indicates the total quantity of hydrogen sulfide plus sulfur dioxide, and a subsequent titration of the resulting solution with standard sodium hydroxide gives an indication of

the relative quantities of the two acid gases present.

Steam generated in the waste heat boiler is utilized for driving the air blower and the sulfur circulating pump. Low pressure steam is used for heating the sulfur pit and all jacketed liquid sulfur lines. Exhaust steam from the turbine drivers is condensed in an air-cooled Fin-Fan condenser. Steam condensate is collected and re-used in the boiler. Product liquid sulfur from the plant is periodically pumped by way of an insulated steam jacketed line to unsheltered storage vats. The walls of the vats are made of two by four studding with corrugated galvanized sheet metal siding. The sulfur is allowed to spread out in a thin layer on the surface and solidify. As the height of solid sulfur increases in the vat, the sheet metal siding is moved up. When a vat is completely filled, the walls are stripped from the sulfur, leaving a large rectangular block which is subsequently broken up for shipment.

Sulfur produced from hydrogen sulfide by this process is extremely pure, analyses indicating a purity better than 99.9 percent. As it has less ash than the mined material, it is excellent as a raw material for chemical manufacture, and improves the sulfur burners.

Foster-Wheeler, Ltd., is building the $350,000 Royalite plant at Turner Valley to process sour gas now being vented at the gasoline plant of Madison Natural Gas Co., Ltd., a Royalite subsidiary. The plant is expected to be on stream this month. As is the case in Jumping Pound, Pincher Creek and other areas in Canada, the Turner Valley distillate and gas cap is rich in sulfur. Content of the crude distillate is 1,150 grains per 100 cubic feet, and of the gas cap, 575 grains. Average wet gas entering the Madison plant contains about 825 grains.

The 67-mile Madison system gathers wet gas from 195 Turner Valley wells. Prior to being delivered to the processing plant, the gathered gas is raised in pressure from 90-125 pounds per square inch gauge to 335 pounds by means of 10 Cooper-Bessemer compressors totalling 5,720 horsepower at an altitude of 4,000 feet in Turner Valley or 6,600 hp at sea level. This is the largest compressor station in Western Canada.

The gathered gas is delivered by the compressors to the absorption plant and then to the processing plant. The processing plant cleans the gas in a Girbotol unit for distribution to consumers by the Canadian Western Natural Gas Co., Ltd. to a local distributing company.

Due principally to climatic conditions, Royalite's gas operations vary from a flow of 100 million standard cubic feet per day in winter to 30 million in summer, with an added 15 percent daily variation.

The waste gas analysis by volume dry basis is approximately 40.2 percent H_2S, 56.8 percent CO_2, and 3.0 percent hydrocarbons. The gas to the sulfur recovery unit flows at 10 psig. saturated with water of 80°F. For a capacity of 30 long tons per day sulfur equivalent, this represents a design acid gas capacity of 2,130,000 SCF/day.

In the Foster-Wheeler sulfur recovery unit the acid gas now being released to the atmosphere will be burned with air in stoichiometric quantity to produce elemental sulfur in the reaction furnace. The vapors are cooled initially in steam generating equipment where some condensation takes place. The condensed sulfur and vapors are passed to a wash tower using liquid sulfur as a cooling medium. Here the sulfur vapors and condensed sulfur are further cooled to a temperature of approximately 275°F.

The gas stream leaving the first wash tower contains unreacted hydrogen sulfide, sulfur dioxide, carbon dioxide, water vapor and other reaction products. It passes to a natural gas fired reheater where its temperature is raised to approximately 500°F. Increased recovery efficiency to a minimum of 90 percent is obtained by passing the gas through the convertor containing a bauxite catalyst. Sulfur produced in the converter is removed in the second wash tower and the spent gases vented to the atmosphere. The condensed sulfur as made flows directly to a rundown tank. Sulfur from this plant will be trucked 17 miles to a railhead at Okotoks for shipment to various points in Canada.

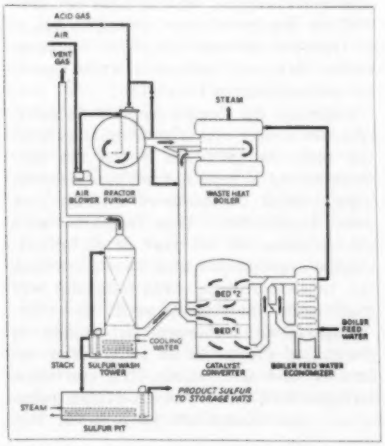
Due to Royalite's varying gas operation as noted before, the design of the plant must be flexible from an operating standpoint. The air for reaction must be continuously metered to suit the variation in acid gas flow.

Since the plant must operate continuously in the extreme winter conditions encountered, the steam generating and sulfur condensing equipment will be partially housed. The combustion air blower will also be located in the housing as will the control equipment.

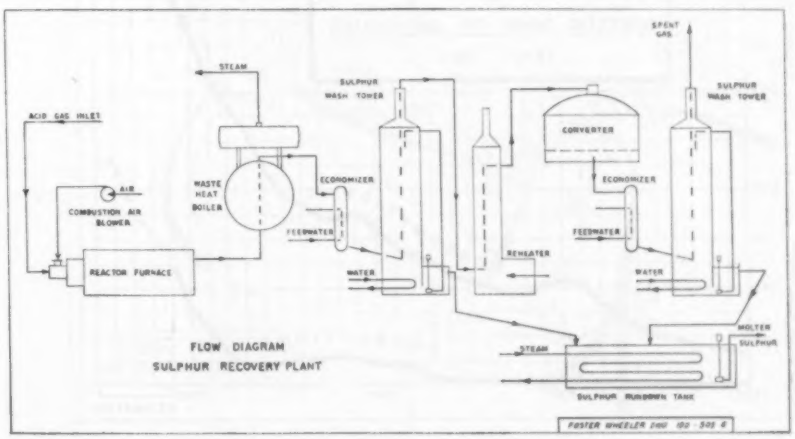
Heat liberated in the process will be used in the main boilers. In order to insure the continuity of operation, all main drives will be by steam turbines, thus eliminating possible shut-down from power failures. Since the Girbotol plant uses steam at 25 psig. for MEA regeneration, turbine drives will exhaust at this pressure.

The prairie provinces of Canada are rich in natural gas as well as oil. Reserves at the end of 1951 were calculated at eight trillion cubic feet, and it is generally conceded that many times this volume will be made available as development proceeds. This makes it clear that there is a bright future for a petrochemical industry based on natural gas in addition to the industry which may be based on refinery tail gases and light products in the eastern refining centers such as Sarnia and Montreal.

Flow diagram of Royalite Oil Company sulfur recovery plant in the Turner Valley field.



Simplified flow diagram of Shell Oil Company's sulfur plant in the Jumping Pound field



CANADIAN OIL CONSUMPTION

THE DOMINION of Canada continues to enjoy a business boom of remarkable proportions. Mining, manufacturing, forestry and agriculture—all are expanding rapidly. Increases in all these activities are exerting a strong influence on demand for petroleum products.

In 1951 domestic demand for petroleum products in Canada averaged 410,700 b/d as compared with 357,900 b/d in 1950 and 313,500 b/d in 1949. Increase for the year was about 14 percent, compared with eight percent in the United States and nine percent in the world as a whole.

Despite the rapid increase in demand, Canada has made great strides in the direction of self-sufficiency in petroleum production since the discovery of Leduc in 1947. Crude production rose 52,100 b/d in 1951 to 130,500 b/d, and natural gas liquids output was up 4,200 b/d. Canada has increased its crude self-sufficiency from 8.1 percent in 1947 to 32.6 percent in 1951. At the end of 1951, the Dominion's fields had a potential of 205,000 b/d at MER. In 1946, before Leduc, Canada's potential was only 19,000 b/d. By 1948, potential had risen to 40,000 b/d, in 1949 to 105,000 b/d, and in 1950 to 168,000 b/d. The increase in six years was 1,100 percent.

Even more spectacular increases in known reserves have been blocked out in the post-war period. In 1946, the total was 45 million barrels. Progress has been about as follows in succeeding years: 1947, 150 million; 1948, 500 million; 1949, 900 million; 1950, 1,100 million; and 1951, 1,364 million. Reserves at the beginning of the current year were 30 times as much as in 1946. This expansion in reserves has cost fantastic sums. Estimates are that exploration and development in six years have cost $577 million, of which $100 million was spent in 1949, $165 million in 1950, and $225 million in 1951.

The expansion of leasing and exploration in the period is indicated in the following tabulation:

Year	Leases and Reservations (Millions of Acres)	Geophysical Parties in Field
1946	20	11
1947	30	23
1948	56	59
1949	115	105
1950	129	125
1951	166	155

The driller has been following closely on the heels of the geologist and geophysicist. Result has been the discovery of a new oil or gas field every week during the past year. Total completions in Canada during the past three years are as follows:

	1949	1950	1951
Oil	583	845	824
Gas	204	197	269
Dry	436	458	617
Total	1,223	1,500	1,710

It is anticipated that about 2,000 wells will be drilled in 1952. Based on results in recent years, oil men in Canada expect to find some 300 million barrels of new reserves this year and to enlarge producing potentials to about 255,000-265,000 b/d. The industry hopes to bring potentials up to 300,000 b/d or more in 1953 to permit a westward movement to the Pacific Coast of about 100,000 b/d and supply all needs of the prairie provinces as well as a good share of Ontario.

In a paper presented to the Canadian Institute of Mining and Metallurgy last January, Dr. Oliver B. Hopkins, vice president of Imperial Oil Ltd., estimated that by 1955 Canada will be consuming about 500,000 barrels of oil daily and producing about 230,000 b/d. If these figures prove to be accurate, Canada will be up to about 46 percent self-sufficiency in three years.

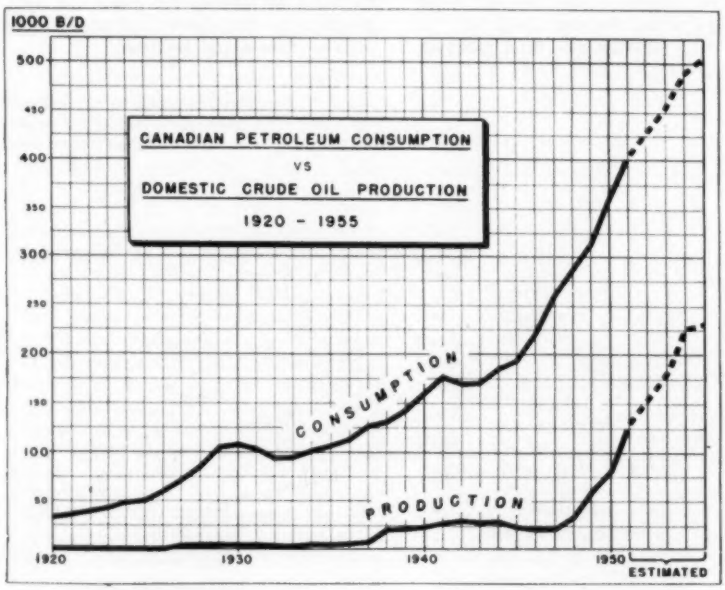
Investment necessary to bring about this degree of self-sufficiency is estimated by Dr. Hopkins at $2,000 million, of which $1,000 million has already been spent since 1947.

Annual reports of major Canadian oil companies for 1951 emphasize the large amount of money which is being invested in expansion. British American Oil Co., for example, earned $11,489,975 in 1950 and made capital expenditures of $21,368,000, nearly twice its earnings. Again, in 1951 B-A invested $33,219,000 in properties, plant and equipment while reporting net earnings of $13,099,301.

Canadian Oil Companies, Ltd. completed a new grease manufacturing and blending plant in 1951 and began the construction of a new $18 million refinery. Total capital expenditures for the year were $13,589,591. This compares with net earnings for the year of $1,148,861. Capital expenditures thus were more than ten times earnings. The company will make heavy investments again this year.

Imperial Oil Ltd. spent $57 million on plants and properties in 1951. New refineries cost $15,600,000, transportation facilities $9,200,000, and production properties and equipment $23,300,000. Net

Canadian petroleum production and consumption curves starting with the year 1920 and projected through 1954.



ROSE 14 PERCENT IN 1951

earnings for the year totaled $35,951,000, so that the company's increase in investment was $21 million more than profit.

Since the discovery of Leduc, Imperial has found it necessary to raise $263,900,000 of new capital. Last year $80 million of stock was sold. Previously Imperial had liquidated some important investments to get ready cash. The large new investment is beginning to pay off. Last year, for example, Imperial increased its crude production 69 percent. Crude and products transported, refinery runs, and sales all showed substantial increases.

From a manufacturing and marketing standpoint, Canadian refiners are experiencing some of the problems faced by United States companies. Most acute problem perhaps is the imbalance between supply and demand for middle distillates. With no natural gas yet available on the Pacific Coast and in the populous central and eastern provinces, the demand for furnace oil has been rising at a very rapid rate. Dieselization of Canadian railroads is proceeding rapidly. At the close of 1950 there were 369 diesel locomotives in service, and at the end of 1951 the number had risen to 630. This was an increase of 71 percent in a single year.

In the United States the average diesel locomotive in railroad service consumes 5,400 barrels per year. Assuming that the ratio of switch engines to main line locomotives is about the same, it may be estimated that last year's new railway diesel purchases will add 1,410,000 barrels to Dominion consumption of diesel fuel. This would be an increase of 16.7 percent over last year's diesel fuel demand which totaled 8,413,000 barrels.

Demand for middle distillates as a whole has increased 58 percent in Canada in the past two years, from 22 million barrels in 1949 to 35 million barrels in 1951. Since 1946, middle distillate demand has risen 145 percent in Canada compared with 71 percent in the United States. Result of the swift climb in distillate demand is that more than 23 percent of petroleum products consumed in Canada falls in this classification. Canadian refineries produced only 29 million barrels of these products, making it necessary to import six million barrels from other countries.

Thus far Canadian refiners as a whole have not felt it necessary to build special coking stills for maximum production of distillates. This may become necessary in the future, however, if the dizzy upward spiral of demand continues.

At the middle of 1951 there were 519,000 oil stoves and 423,000 domestic oil furnaces installed in Canada. Consumption per unit is about the same as in the United States. Indications are that domestic furnaces consume about 42 barrels per year and stoves 39 barrels.

Residual fuel also enjoys a good market in Canada. Domestic consumption in 1951 was 32 million barrels, compared with 27 million in 1950 and 24 million barrels in 1949. In the past five years consumption of heavy fuels has increased 81 percent in Canada, compared with 17 percent in the United States.

Canadian refineries produced 328,200 barrels of refined products daily in 1951, compared with 278,100 b/d in 1950 and 182,900 b/d in 1946. Increase during the five years was 79.6 percent. It is estimated that Dominion capacity will be increased another 50,000 b/d by the end of 1954. At the present rate of demand increase, this expansion will not be adequate to take care of domestic requirements. It will be necessary to import large quantities of foreign products as it has been in recent years.

The editors of WORLD PETROLEUM are indebted to John F. Fairlie, manager of the coordination and economics department of Imperial Oil Ltd., for his generous assistance in supplying data for the above article.

PROGRESS TOWARD SELF SUFFICIENCY

	Production (Thousands of Barrels)	Needs	Percent Sufficiency
1946	7,607	80,968	9.4
1947	7,729	95,943	8.1
1948	12,368	105,082	11.8
1949	21,487	114,426	18.8
1950	29,058	130,460	22.3
1951	48,123	150,400	32.6

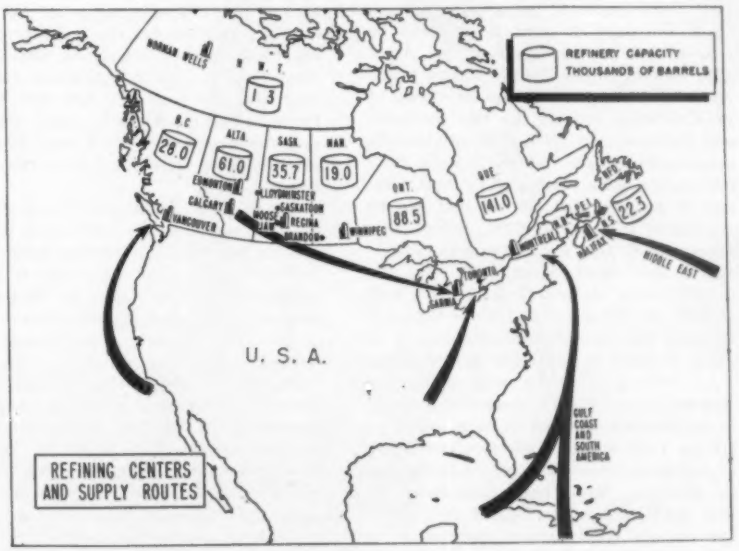
CANADIAN MOTOR VEHICLE REGISTRATIONS

	Cars	Trucks & Buses	Total Motor Vehicles
1935	989,744	174,623	1,164,367
1940	1,234,637	250,550	1,485,187
1945	1,160,058	319,609	1,479,667
1950	1,650,641	544,288	2,194,929
1951	2,070,000	690,000	2,760,000

CANADIAN SUPPLY AND DEMAND FOR OIL
(Thousands of barrels daily)

Demand	1949	1950	1951
Total Demand	315.1	359.0	412.9
Exports	1.6	1.1	2.2
Domestic Demand	313.5	357.9	410.7
Supply			
Crude Petroleum	57.5	78.4	130.5
Additives (1)	6.6	5.0	9.2
Crude Imports	206.7	224.1	226.8
Product Imports	44.2	63.0	68.5
Total Supply	315.0	370.5	435.0
Inventories			
Stock Changes	—0.1	+11.5	+22.1

Map showing location and concentration of Canadian refineries by provinces, together with their supply sources.



WESTERN CANADA'S NATURAL GAS

BY FLOYD K. BEACH

EXPORT of natural gas from Alberta to Montana's Anaconda copper refinery started in February, 1952. Permission to export limited quantities of gas from an area in northwestern Alberta to Pacific coast points was granted by the Alberta Legislature in April, 1952. Recognition was given to the rate of gas discovery when the Conservation Board's 1952 report was tabled, with the forecast that a trillion cubic feet of reserves might be added annually for the next eight years, and the way is opened for future reconsideration of the very limited export permission now granted.

The plains of western Canada from western Manitoba to the foothills of the Rocky Mountains have been for years an outpost of the oil and gas industry which has had relatively little exploration.

A map of Alberta showing oil and gas fields suggests that exploration has been quite thorough, but at a very small scale, the area of most fields must be exaggerated in order to show up. Actually, Alberta covers 255,285 square miles. After deducting 8,000 square miles of pre-Cambrian outcrop in the northeast and 15,000 square miles of mountains, the possible oil and gas country is about 225,000 square miles in area. The total number of wells drilled for oil and gas to the end of 1951 is only 5,155, and at least two-thirds of that number was in closely-spaced field development wells. On the basis of total wells, this is only one well to 43½ square miles, and if we take out the field development wells, the density is about one well to every 130 square miles.

In 1951, 1,197 wells were drilled in Alberta alone, 412 of these being rated as exploratory and 305 as rank wildcats. Of the rank wildcats, 46 were completed as gas discoveries. It might be optimistic to say that these wells discovered 46 new fields, but when located they were far enough from earlier discoveries to warrant their being classed as wildcats and they were cased for later gas production.

Saskatchewan recorded two gas discoveries out of 49 wildcat wells, and British Columbia recorded three gas discoveries out of 14 wildcat completions. The three British Columbia gas discoveries were close enough to each other to suggest a single field. Several gas discoveries early in 1952 appear to add materially to gas reserves in Alberta and British Columbia.

Natural gas was encountered during the drilling of a water well when the Canadian Pacific was being built in 1883, and after earlier signs of gas at Medicine Hat, a well drilled in 1904 found a dependable supply for the town and led to installation of street lights that were left burning day and night. Fuel supply for domestic and manufacturing purposes became an attraction to bring new population to the locality.

Calgary received a supply of gas from the Bow Island field in 1912 through a 16-inch line 170 miles long—at that time a record venture for the industry. The supply approached exhaustion some eight years later and led to exploration for gas near the pipe line, but this exploration failed to find much gas to supply the line save for the Foremost field, some 20 miles south of Bow Island, and it is relatively small.

Gas was discovered near Viking during the first war and was later piped to Edmonton, but that discovery was made while looking for oil. Gas was found in small quantity in Turner Valley in 1914 while looking for oil, and in 1924 a large flow of gas from Royalite 4 was found, also in the search for oil.

During the second World War there were two gas-finding programs at work: Imperial explored the Kinsella field east of Viking, and the team of McColl-Frontenac and Union Oil Co. of California explored in the area to the south and east of the Foremost field. Both of these programs had as their objective the synthetic production of oil after a considerable amount of exploration for oil had failed to find reserves adequate to supply the Canadian prairie market. The two programs proved up considerable reserves of gas by wells spaced roughly at six-mile intervals, although somewhat closer at times.

The discovery of Leduc oil field in 1947 and Redwater in the following year with reserves of oil so great as to demand an outlet beyond the limits of the Canadian prairies, put a stop to plans for synthetic oil and left Alberta with gas reserves of an order that had not previously been suspected, and the very active exploration for additional oil fields that has followed the discovery of Leduc has turned up gas discoveries over a wide area. These gas discoveries have introduced a problem to the people who have made the discoveries. Are the discoveries and the money used in finding them to be written off as a loss, or are the gas wells to be considered assets? The owners see no hope of their becoming assets unless a market outside Alberta can be found.

In 1949 the Alberta Legislature passed "The Gas Resources Preservation Act," which provides that the Petroleum and Natural Gas Conservation Board shall not grant a permit for the removal of any gas from the province unless such gas, in the opinion of the Board, is surplus to the present and future needs of the people of the province. There is also in the "Oil and Gas Resources Conservation Act," a provision that no gas produced in the province shall be used or consumed in the province for any purpose other than for gas lift, repressuring, recycling, pressure maintenance, or for light or as fuel, until a permit authorizing its use or consumption for such purpose is granted by the board. This provision therefore puts much control of the uses that may be made of gas within the province in the hands of the Board and prevents the inception of enterprises that might use gas wastefully.

In addition to the legislative acts that

Floyd Kellogg Beach, born and educated in Michigan, came to Canada as a young man, and after a career in several branches of engineering work and service with the Canadian Army in World War I, entered the oil and gas industry in 1927. He served for a time with the Dominion Government and, when the western provinces obtained control of their natural resources in 1930, entered the service of the Province of Alberta. Shortly after the Petroleum and Natural Gas Conservation Board was established in 1938, he was transferred to its staff, retiring in 1950. He has since practiced as a consultant, and is western field editor for Canadian Oil and Gas Industries.

have been passed, the Hon. N. E. Tanner, Minister of Mines and Resources, has enunciated the policy of the Alberta Government, stating that it will not object to the export of gas if it be shown that there is an adequate reserve with suitable deliverability after Alberta needs have been provided for.

The problem of deciding on the size of reserves, deliverability and future demand has been assigned to the Petroleum and Natural Gas Conservation Board, and that body has taken the matter in hand. From the nature of the terms of the acts, they appear to feel that reserves must be quite fully demonstrated before accepting them as "established"—a term used in their 1951 interim report. However, the development of gas fields is a highly expensive operation, and normally proceeds only as immediate demand for the gas warrants the expenditure; this fact of life makes the actual proving of "established" reserves rather difficult. The Board has until very recently looked coldly on forecasts based on statistical studies that involve the number of cubic miles of sediments, density of drilling and proportionate success already attained.

At this point we must remark on the advances made in reservoir engineering in recent years. When the Bow Island field was discovered, cable tools were used. The sand was merely touched, casing set without even the benefit of cement to anchor it in place, and some kind of test of rate of flow was made. The pressure would be measured after closing the well in, and for lack of calibrating equipment, the gauges used might be seriously in error. Thus, about the only recorded observations about a well were open flow rate and closed pressure. The pipe line to Calgary and Bow Island was laid with no further knowledge of the probable quantity of gas in the reservoir, although

Pacific Petroleums' Fort St. John No. 1, drilled in last November, started a flurry in British Columbia.

a number of wells had been drilled suggesting that the field extended for three or four miles along the river.

Today, tools for making drill stem tests make drilling by rotary tools acceptable even for exploratory drilling. Coring gives consolidated samples of a producing rock that can be taken into the laboratory for analysis of porosity, permeability and water content. Electrical logging reveals the exact thickness of pay and corrects for the lag in arrival of drill cuttings to the surface. Radio-active logs even permit logging through casing; a log of the gamma rays emitted by the rocks at various depths and of neutron absorption at the various depths, when taken in connection with core analysis, provides much detailed information about the reservoirs. Gun perforating and jet perforating services permit of drilling right through a pay horizon into water, setting of casing through the pay, and selective perforation of the most favorable horizon after evaluating the total thickness and porosity. If the pay is oil, statistical analysis of many fields and their performances permit estimating probable recovery, while if the pay is gas, instruments for measuring bottom hole pressure give much data on actual pressure in the pay horizon, and experience in many fields permits forecasting what proportion of the gas in place can be recovered and how much flow can be expected at various stages of depletion.

With all this detail about a given well, there remains the problem of forecasting the areal extent of any given gas discovery. Seismic surveys sometimes give indication of the area involved in the structure. Such surveys are perhaps the most hush-hush of a company's assets, but in spite of this fact, many companies have co-operated in supplying consultants with data, since they know that gas discoveries are not assets until a market is established. Aside from seismic surveys, studies of regional thickening and thinning of sands afford much information as to probabilities. Study of the records of all wells around gas discoveries thus becomes very pertinent, and again co-operation between competing companies becomes of benefit to all.

Pursuant to the instructions of the Alberta Legislature, the Conservation Board held hearings over a long period in 1949-1950. Several of the applicants to export gas from the province submitted estimates of reserves. Dr. G. S. Hume of the Dominion Government's Department of Mines and Resources had led off with a study of gas reserves before the province of Alberta acted. Dr. A. W. Nauss presented to the Board an estimate of gas reserves and others did likewise. Most of these estimates depended to quite an extent on estimates made for various fields by the company most interested in the particular field, with perhaps rather sketchy coverage of isolated gas occurrences about which there was not too much data. Reserve estimates by five companies applying for export ranged from 4,684 to 7,023 billion cubic feet (MMMcf). The lowest estimate came from a company which at the time had the most modest export proposal. The Board brought out an interim report early in 1951 which showed in essence that there were reserves as of Jan. 1, 1951 as follows:

	MMMcf
For local use	382
For general use	4,057
Beyond economic reach	219
Total	4,658

Against these reserves, the board forecast foreseeable needs of the province at 3,056 billion cubic feet. Of more concern than the small margin above requirements was the fact that both of the large systems of gas distribution in the province would be unable to meet their demands from presently connected fields long before 30 years have passed.

The Board's 1951 report showed that by 1956 the presently connected fields supplying Calgary would begin to show a deficiency, and it would continue to increase until in 1980 there would be an annual deficiency of nearly 46 billion cubic feet out of the 52 billion required that year, and an accumulated deficiency of 606 billion to the end of 1980. Peak day deficiency in 1980 would be around 238 million cubic feet even by using Bow Island field storage merely to meet peaks.

The Edmonton system is expected to show deficiency in 1960, and by 1980 the presently connected fields will be short 48 billion out of 68 billion cubic feet required. The accumulated deficiency of 1980 would amount to 475 billion cubic feet, and peak day deficiency about 335 million.

Obviously both Calgary and Edmonton systems will require connection with new fields if they are to meet demands. The existing systems were built when cost of materials and labor were much lower than now. New transmission systems will be more expensive and if the costs are to be paid out of Alberta consumption, some increase in the price of gas is to be expected.

Applicants for export of gas have claimed in their submissions that gathering and transmission lines intended for export would make possible the supply of added reserves for the use of the Calgary and Edmonton systems as part of their projects, and thus would make possible continued Alberta supply without so great a need for increase in the cost of gas to Alberta consumers.

The Board pointed out the problem that exists in using gas from Pincher Creek. That field is most expensive to drill, owing to the great depth. Before gas can be marketed, it must be stripped of liquid fractions, sulfur and carbon dioxide. To do this demands costly plant, and in order to be an economic operation, a high load factor is imperative. With plant of fixed capacity, the field is not adapted to meeting peak loads which the Canadian climate makes very necessary, and during the summer, Alberta demand would leave much capacity unused. Various applicants for export have shown that new discoveries have made a change in the overall picture of reserves, and only by export could the load factor be sufficiently improved to make Pincher Creek field truly economic.

Up to the time of the 1951 interim report by the board, one applicant for export had not finished a survey of gas reserves. The company, Canadian Delhi, retained the services of DeGolyer and MacNaughton to make an entirely independent survey. The consultants spared no pains to gather basic data about every measurable occurrence of gas in the province. They made a preliminary submission of two volumes, replete with maps and tables, dated April 15, 1951, but it was actually presented early in May. On August 1, 1951, they brought in a revision which evaluated discoveries since the first submission and added a volume on deliverability from all fields considered tributary to their export proposal.

Total reserves were approached under various categories in each area. First they delineated, from the best information available, an area they considered as proved. This was usually surrounded by an area considered as probable, and another outline in which it was considered that gas was possible.

The preamble to the book reads:

"*Proved reserves* are reserves proved for oil or gas production in the reservoir by actual well tests, either in the cased hole or by definite open hole drill stem tests. These reserves are defined by reasonable geological interpretation of structure and known continuity of oil and gas reservoir material above limiting water saturation.

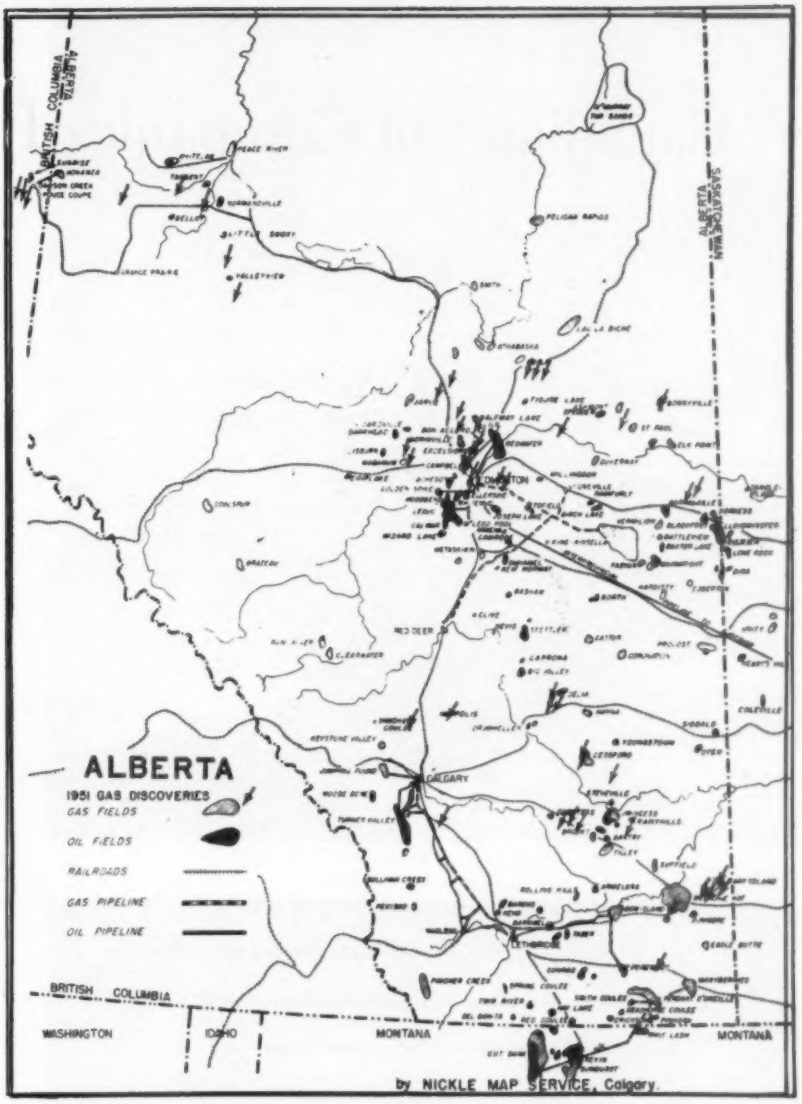
"*Probable reserves* are considered as essentially proved, or capable of being proved by less direct well control, but based again upon evidence of producible gas or oil within limits of a structure or reservoir above inferred or known water saturation.

"*Possible reserves* are similarly determined, but may be based upon electrical log interpretation or widespread evidence of commercial gas saturation defined by widely spaced wells. It may also include areas of geophysical anomaly that are immediately adjacent to proved productive areas of like geophysical character."

We add the comment that the possible reserves do not include such things as probabilities based on trends which, no doubt, later discoveries will add to the general picture of gas reserves.

Having defined the meanings of the various categories, DeGolyer and MacNaughton show, in the August 1 book, reserves as of Jan. 1, 1951:

Map showing gas discoveries during 1951 in Alberta.



	MMMcf
Proved	8,553
Probable	2,510
Possible	2,644
Total	13,707

Of these reserves, they consider what gas is adjacent to their projected gathering lines after omitting reserves committed to Alberta consumers and show reserves for their client as follows:

	MMMcf
Proved	3,731
Probable	1,590
Possible	1,429
Total	6,750

of which there is available for sale 4,407 MMMcf.

In a paper delivered at the A.I.M.E. Annual Meeting Feb. 18-21, 1952, Messrs. Dougherty, Folger, Lowe, Meyer, and Trostel covered Alberta natural gas reserves, bringing the figures of Aug. 1, 1951 up to date as of the close of 1951. They show that 104 fields contain 11,700 MMMcf proved and probable, and for 187 known areas capable of production, reserves are in excess of 16,000 MMMcf if we include the category "possible." Five fields—Pincher Creek, Leduc-Woodbend, Viking-Kinsella, Cessford, and Medicine Hat—have recoverable reserves of more than 1,000 MMMcf each. Twenty-four fields, including those just named, have reserves in excess of 100 MMMcf each, and these 24 fields contain 79 percent of the total reserves in Alberta.

The reserves are 56 percent in sediments of Cretaceous age, 30 percent in Mississippian, 10 percent in Devonian, 3 percent in Triassic and 1 percent in Jurassic and Permo Pennsylvanian sediments.

Westcoast Transmission Co., Ltd., backed by Pacific Petroleums, proposed transmission by an all-Canadian route crossing the Rocky Mountains by a northern pass and extending, after reaching Vancouver, to Seattle and Portland, serving various communities near the main route. A branch from the main line in British Columbia would serve Spokane and Hanford, Wash., Wallace, Ida., Trail, B. C., and other points along the route. Pacific Petroleums and associates or subsidiaries have been conducting an energetic program of exploration for gas in the northwestern part of Alberta and the adjoining part of British Columbia and actually control considerable reserves of gas.

Northwest Natural Gas Co., backed by Brokaw, Dixon and Associates, proposed a route from southern Alberta through the Crowsnest Pass to serve much the same territory as that mentioned in reference to Westcoast, but their route would pass through Washington before reaching Vancouver. Northwest has done no prospecting for gas in Alberta and holds no leases so far as we are aware, but has made contracts to purchase gas from various owners of gas reserves. Any contracts so made have now lapsed unless renewals have been made without public announcement. Should Northwest receive an export permit, the contracts could doubtless be renewed.

Prairie Pipelines proposed a route somewhat similar to Northwest, save that the line would go farther west in British Columbia, to serve Trail before turning south to Spokane. This company has very recently come up with a scheme coupled with the proposal for export from Alberta, to take Texas gas to Ontario.

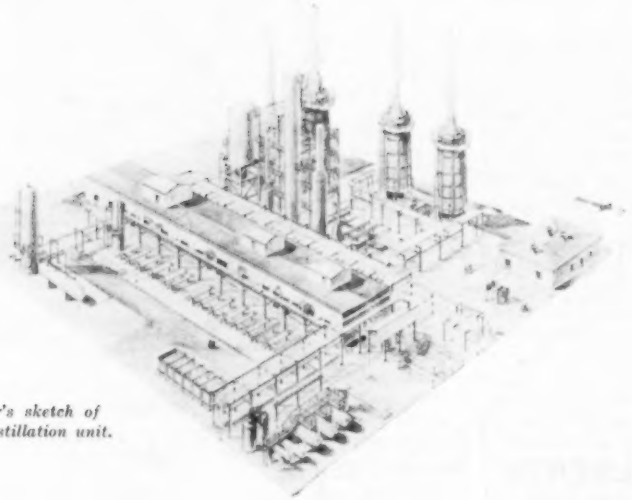
Tennessee Gas Transmission Co. has recently proposed to deliver gas from Texas (or vicinity) to be transmitted through several pipe lines to New York, and through a line across the Niagara river for distribution in Ontario by Niagara Gas Transmission Ltd.

Alberta Inter-Field Gas Co. Ltd. is a company that proposes to build gathering lines. It would facilitate deliverability within the province and could also work with an export company.

Western Pipe Lines proposed transmission of gas to Winnipeg and to cities along the route, thence to the U. S. Canada boundary where gas would be picked up by one or more American pipe lines for supplying parts of North Dakota and Minnesota. They have done no exploration of which we are aware and would depend on purchasing gas from owners of gas reserves.

(Please turn to page 128)

Canadian Oil Companies Refinery Begins



Engineer's sketch of crude distillation unit.

One-fifth of Canada's recent deficiency in oil refining capacity is being made up by the new $22 million refinery now going on stream near Sarnia, Ont. Built "from the ground up" as an entirely new plant, the refinery is designed for maximum production of gasoline and other high quality fuels and petrochemical intermediates. A remarkable record for speed was made in building the plant on schedule despite bad weather and materials shortages.

BY E. A. SMITH and F. J. MASLYK

E. A. Smith is manager of manufacturing, Canadian Oil Companies, Limited; F. J. Maslyk is project engineer, Stone & Webster Engineering Corporation.

CANADA'S newest major refinery is coming unit by unit into full-scale production at Sarnia, Ontario, where Canadian Oil Refineries Limited is investing $22 million in plant and equipment. The firm is the wholly-owned refining subsidiary of Canadian Oil Companies, Limited, one of the country's petroleum industry pioneers. Its refinery caps a $26 million post-war expansion program.

The refinery claims two "firsts": Canada's first catalytic Platforming unit and Ontario's first catalytic cracking unit. Cat cracker and auxiliary units began functioning last month. Other sections are being activated on a pre-arranged program. The complete refinery is scheduled to be in action within weeks.

Fast-rising civilian demands for motor fuel and other products in Canada's most heavily populated and highly industrialized province, which consumes half the nation's quota, impelled establishment of the refinery and choice of its site.

Outbreak of the Korean War while the refinery project was still in the survey stage added the urgency of defense requirements to construction plans and time schedules. Canada's government gave full approval to the refinery as essential to defense in its own right as a processor of petroleum and as a new key source of ingredients for other defense plants.

But Canada still depends on United States mills for much of its steel, and despite Canadian Oil's allotment from the closely-controlled national steel supplies, material problems were many and unceasing. Oil and construction industry spokesmen therefore consider it spectacular that in the face of constant obstacles the refinery is going on stream practically as scheduled before the Korean conflict began.

It is remarkable that design, procurement and construction were carried out on schedule during a most critical period of that war and that the bulk of construction was accomplished during the winter months of 1950-51 and 1951-52. Canadian Oil executives and the staff of Stone & Webster Canada Limited, the project managers, drove hard ahead under the impetus of defense needs and helped solve supply problems as they arose.

Speed with which critical materials were obtained again and again, just as

Construction forged ahead through two Canadian winters. This photo of a vis-breaker tower being slung into position was taken in January.

Operations

imminent shortages threatened building delays, attests to the all-out cooperation of Canadian and United States government agencies and teamwork of the many contractors, manufacturers and suppliers in combatting bottlenecks. Supply crises were not confined to steel, but the magnitude and solution of the steel problem illustrate the over-all and recurring search for vital materials. In steel alone, some 19,000 tons were needed for the storage tanks and processing equipment. Four thousand more tons of steel went into the 75 miles of piping for the refinery. Under normal conditions steel tonnage would have been even greater, but substitutes were used to the fullest possible extent.

Defense importance of the refinery to Canada's national defense and to the nation's contributions to the North Atlantic Treaty Organization is underlined in announcements that the refinery will supply aviation gasoline, fuel for jet aircraft, butylenes for the manufacture of synthetic rubber, and ingredients for synthetic chemicals.

Synthetic rubber is made at the nearby federally-owned Polymer Corporation, the only synthetic rubber plant in the British Commonwealth of Nations. Ethane, propane and ethylene gases will be supplied to another neighbor, Dow Chemical of Canada Limited. Both plants are connected with the refinery by systems of pipelines.

Canadian Oil's refinery occupies a 200-acre site which allows space for expansion. Immediately adjoining it beside the St. Clair River is a second 200-acre area, held in reserve for further expansion or for allied industries, with access to highway, railway and Great Lakes transportation facilities.

The refinery is designed to process 5,000,000 barrels of Redwater, Alberta, crude oil annually at a rate of 20,000 barrels per day. Other types of crude oil may also be handled should the occasion arise. Additional annual capacity can be obtained by increasing storage and by providing more winter loading facilities.

Canada's first catalytic Platforming unit in foreground. Cat cracker and crude distillation groups center and right.

In general, output of special products was avoided at this time to simplify design and expedite commencement of manufacturing. Sufficient flexibility was provided, however, to permit special products with minimum additional equipment. In addition to making its own fuel gas and oil requirements, the refinery will at the outset make premium gasoline, regular gasoline, stove oil, No. 2 fuel oil, bunker fuel oil, propane, butane-butylene, and sales gas. No additional equipment will be needed to produce high quality aviation gasoline.

Heart of the refinery is in its three main process unit groups. General service systems and utility systems to serve the process groups contain ship docks, storage tanks, truck and tank car loading terminals, oil transfer, steam generation and distribution, service air, fuel, water, chemicals, and power distribution systems, complete waste disposal facilities, plant protection devices, communication systems and a laboratory for control purposes. Additional features include a complete grid of paved roads serving the refinery, railroad siding, offsite pipe line systems, dual metering station and two pipeline bridges spanning Talfourd Creek, which flows diagonally across a corner of the property into the St. Clair River.

The three main process unit groups consist of:

The Crude Distillation Unit: designed by the Badger Process Division of Stone and Webster Engineering Corp. and constructed by Stone and Webster, Canada, Ltd.

The Catalytic Platforming Unit: designed by Universal Oil Products Co. and constructed by its subsidiary, Procon, Inc.

The Catalytic Cracking, Gas Recovery and Catalytic Polymerization Units: constructed by the Canadian Kellogg Company Limited, from designs furnished by M. W. Kellogg Co. of New York.

Coordination of the design and construction of the process unit groups and general facilities, including administration of all contracts, was handled by the project managers. The firm of Proctor, Redfern and Laughlin designed the water supply systems including water treating, waste disposal facilities, and part of the plant protection devices.

History of the parent company dates back to 1908. In that year National Refining Co. of Cleveland, Ohio, acquired the Canadian firm and operated it as a subsidiary until 1938, when National sold its Canadian interests to a firm of investment bankers, Nesbitt, Thomson and Co., Ltd., of Montreal. Development and extension of Canadian Oil Companies, whose marketing organization had far outgrown its refining facilities, were halted when Canada went to war a year later, in 1939. With the end of the war in 1945, plans were made to extend the facilities across the country to include many new outlets, general improvement in distribution, and the erection of strategic marine terminals in the Great Lakes area and ocean tanker terminals on the St. Lawrence. Considerable extension of refining capacity also came under discussion, since the then-existing refinery at Petrolia, Ontario, was out of balance and was rapidly approaching obsolescence. In 1949 it was decided to engage the firm of Stone and Webster Engineering Corp. of Boston to study the refinery problem in detail.

Among the principal conclusions and recommendations made by Stone and Webster as a result of lengthy studies were:

1. The company should build a modern refinery to supply a major portion of the gasoline which it markets, provided the physical and contractual arrangements could be made to assure a reliable supply of crude oil.

2. The refinery should be located in the general vicinity of Sarnia.

3. The refinery should have processing equipment and general facilities with a daily stream capacity of 20,000 barrels of crude oil.

4. The refinery should, in general, serve the southwestern part of the peninsula of Ontario and the area of western Ontario along the shores of Lake Huron and Lake Superior.

5. The design should be for high yield of superior grade gasoline, using atmospheric and vacuum distillation, catalytic reforming, catalytic cracking and catalytic polymerization processes.

As a result of these recommendations and further studies, Canadian Oil Companies, Limited, late in 1950 authorized Stone and Webster Canada Limited to proceed with the management of design and construction of the new refinery on a site on the St. Clair River just outside the city limits of Sarnia. At that time negotiations were well advanced for an adequate supply of crude oil from Alberta. A little later Canadian Oil contracted for a 5,000,000 barrel per year supply of Alberta oil for 10 years. It flows to the lakehead via the Interprovincial Pipeline in which Canadian Oil has a substantial investment.

Crude oil is unloaded from lake tankers at the new steel ship docks into floating roof storage tanks which comprise a part of the 2,000,000 barrel storage system. The crude is then withdrawn continuously from the tanks at a daily rate of 20,000 barrels into the crude distillation unit for separation into finished or intermediate products.

The major operations carried out are chemical desalting, preflashing, dry distillation under slight pressure followed by distillation under high vacuum, and viscosity breaking. Light gasoline, stove and diesel oil products are individually treated for removal of any traces of undesirable materials and sent to storage tanks.

Heavy residual oil not required by the refinery is blended with lighter materials within the unit into bunker fuel oil product and delivered to storage tanks.

Intermediate products normally include low and high pressure gases, stabilized light and heavy naphtha, stove oil and three gas oil cuts. Naphtha may be pumped directly to the catalytic reforming unit or to intermediate storage. The remaining streams are delivered to storage and to the catalytic cracking, gas recovery and catalytic polymerization units for further processing. Should any of the liquid products be found to deviate from rigid specifications, they may be instantly diverted to separate storage for re-processing.

Unique features of the unit consist of a semi-graphic instrument control room containing the most modern types of instruments, placed in a setting of warm colors and soft lighting to permit instantaneous detection and correction of even the slightest irregularities in operation. The controls for the catalytic platforming unit are also included in this room. A permanent colored line chart is installed over the instruments to assist the operators in visualizing the entire processes and the exact condition at any given instant.

The building housing the principal pumping equipment is divided into three distinct compartments, each adequately heated and ventilated for fire protection.

Large inspection sumps are provided in this and the remaining two process unit groups to permit immediate diversion of effluent water to the oil separators. Suspected streams of water which may contain traces of oil are continuously diverted to the oil separators before being delivered to Talfourd Creek. Noxious or undesirable gases which might contaminate the atmosphere are destroyed by burning.

The naphtha intermediate product stream from the crude distillation unit is not suitable for gasolines in its existing form. The stream is therefore processed in the catalytic Platforming unit to elevate the octane rating. This is accomplished by contact with a special catalyst material containing platinum, a unique feature in Canada.

The design capacity of the Platformer is 3,800 barrels daily, resulting in high recovery of gasoline which may be separrated in the unit into aviation and high premium quality fuels.

The three gas oil intermediate products from crude distillation are delivered directly to the cracking unit without being cooled for conversion into gasoline and other products. Variations in the gas oil production rate are balanced by diverting a portion through a cooler to a large storage tank. The cracking unit is a fluid "Orthoflow" type in which the converter consists of both reactor and regenerator in a single vessel. The unit is a "first" in Ontario and is the third of such design by Kellogg. It represents a significant simplification of earlier designs by the elimination of all large catalyst piping, expansion joints and valves external to the vessels. Both the spent and regener-

ated catalyst lines are straight lines which are contained within the converter vessel itself.

The design of the units has been arranged to permit operations over a wide range of conditions as may be necessitated by feed stock availability or product sales requirements.

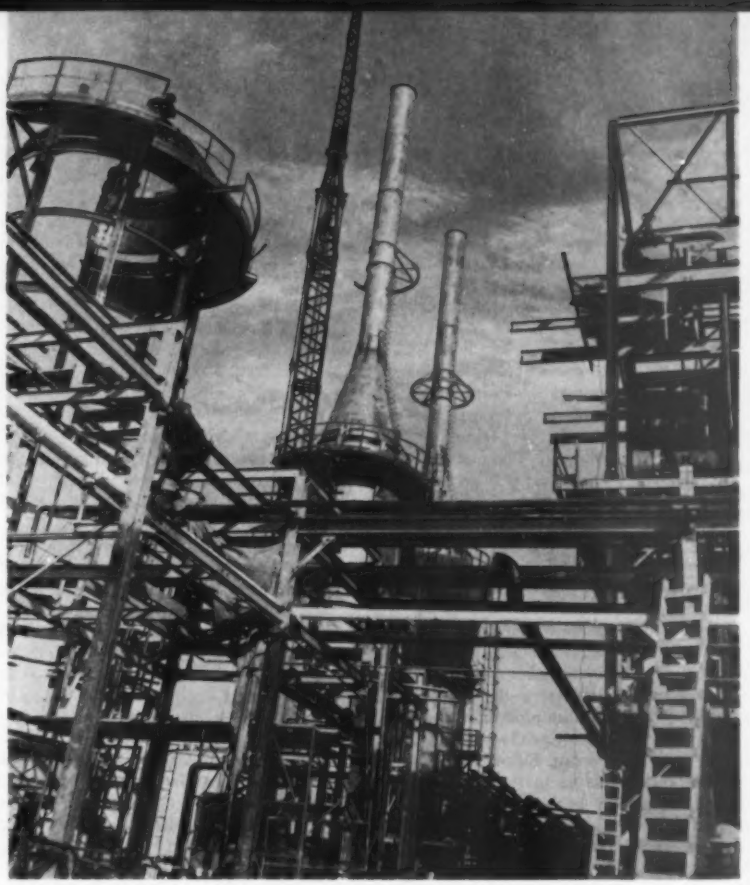
The cracking unit normally produces a gasoline, a light gas oil suitable for No. 2 fuel oil, and a blending oil which is used to dilute the residual fuel produced in the crude unit. Heavy oil may also be produced as a byproduct. Compression of the gases produced in the cracking unit is effected by means of turbine-driven centrifugal equipment and delivered to an absorber-stripper system designed for high propylene retention. In this system the ingredients for manufacture of synthetic chemicals are removed, purified and delivered by pipeline to Dow Chemical of Canada Limited, in Sarnia. The unit, in conjunction with the gas recovery and catalytic polymerization units, yields a propane product conforming to conventional LPGas propane vapor pressure specifications. This product is also delivered to Dow by means of a pipeline or may be shipped in tank cars. Portions of materials which are not usable by Dow are returned to the refinery in a separate pipeline and reprocessed.

Materials produced in the cracking unit which are too light for gasoline are combined with the low and high pressure gas and stabilizer overhead intermediate products from the crude distillation unit in the gas recovery unit. Selected ingredients are allowed to combine with each other in the presence of a special catalyst in the catalytic polymerization unit to produce an unusually superior octane gasoline product which is delivered to the storage tanks.

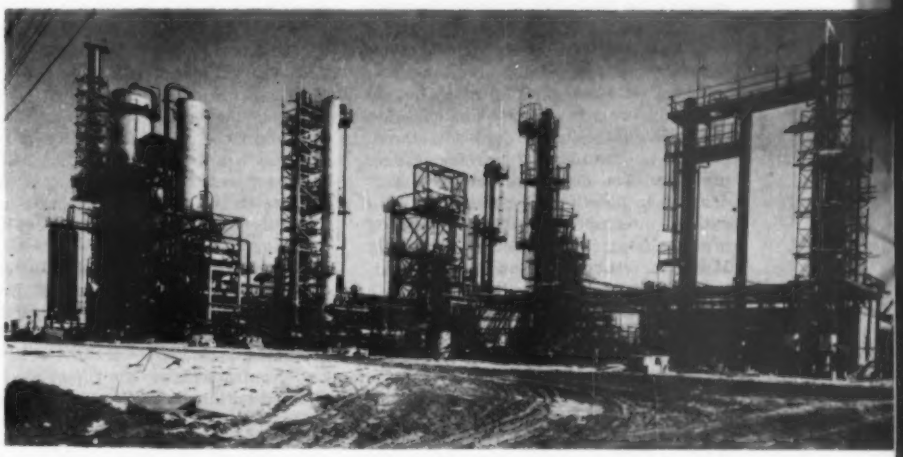
Provision has been made in the design of the catalytic polymerization unit to permit segregation of butylenes produced in the cracking unit for delivery by pipeline to the federally-owned Polymer Corporation in Sarnia for the manufacture of synthetic rubber.

Precise control of operations of all units is contained in a single control room panel similar to the panel and setting in the crude distillation unit.

The products made in the process unit groups which are delivered to the storage tanks are transferred or blended into



Foster-Wheeler vertical furnaces being erected as part of crude distillation unit.



The catalytic cracking unit—first in Ontario.

Circular oil-water separator pits are unique features.

separate tanks by a group of pumps contained in the transfer pump house.

Gasolines are specially processed and segregated to prevent storage and handling losses. Gasolines are blended to the desired grade immediately before shipment. The blending includes the addition of butanes for rapid engine starting, oxidation inhibitors, anti-knock fluid if necessary, and the required dye color. The entire blending operation is performed automatically by means of a special robot designed for this purpose. If desired, blending may also be performed without the automatic devices. The blended gasoline may be pumped directly to boats for shipment or to separate tanks for delivery by tank car or tank trucks at a rate of 5,000 barrels per hour.

Stove oil, diesel oil, No. 2 fuel oil and bunker fuel oil products are normally gauged and re-tested in their tanks and pumped directly to boats or to separate tanks for shipment by tank car or tank trucks at the same rate as gasoline. All bunker fuel oil tanks are steam coil heated and the corresponding pipe lines are steam traced and insulated to prevent congealing.

Over 2,000,000 barrels of storage tank capacity is available in the refinery, utilizing cone roof, floating roof, hemispheroid, spheroid and bullet-type pressure varieties. Each tank was carefully designed for its intended services and provided with the latest protective devices. Freeze-proof water drainage connections are provided, including a drainage piping system for cleaning or emergency evacuation into special handling equipment for recovery of all traces of oil before discharging the water. Adequate dykes are provided to contain any spillage. The dykes can be drained for oil recovery.

Two steel docks, the first of their kind in Sarnia, are provided, one for unloading crude oil with provisions for loading products in the future, and one for loading products. The docks are separated sufficiently to permit the operation of both without interruption. Sufficient piping is provided to unload crude at approximately 15,000 barrels per hour and to load products at 5,000 barrels per hour.

Each dock has facilities for bunkering ships with diesel and bunker fuel oil. Drinking water, compressed air and steam are also available. Spillage of oil is contained in built-in sumps on each dock and is pumped together with bilge from ships to oil recovery equipment. Suitable racks and derricks are provided to facilitate handling of hoses at the docks.

Six tank trucks may be loaded simultaneously from three loading spots under a steel supported canopy with space provided for additional stations. Products can be delivered from the storage tanks to trucks at the rate of 500 imperial gallons per minute per truck by means of swivel loading arms. Air eliminators and ticket printing meters are provided on all products except bunker fuel oil. The dock was originally designed to accommodate 4,000-imperial-gallon trucks but was modified in the latter phases of construction to accommodate 5,200-imperial-gallon trucks for gasoline. A gate house controls the flow of traffic and is provided with emergency pump controls.

A grated steel structure provides space for 26 tank cars which may be filled with products from the refinery including propane and butane. Products are delivered from separate tanks by means of pumps directly to the cars through swivel loading arms. Each loading station has facilities for draining the tank cars through a system of pipe lines leading to the oil recovery equipment. The loading rack has been designed for future extension as required.

A separate canopy covers three sets of meters on products shipped by pipeline to Dow and Polymer and three sets of meters on materials returned to the refinery. The meters are installed in series on each line for check purposes. Any meter may be removed from the line without disturbing the others. Calibrated meter runs are provided to insure the greatest possible accuracy.

All steam used in the refinery is generated in one of two Babcock and Wilcox and Goldie McCulloch Ltd. boilers. Each boiler has a capacity of 100,000 pounds of superheated steam per hour.

The principal use of steam is for operation of the process unit groups and to maintain the required fluidity of heavy products in the storage tanks. Supplementary steam is produced for process use in two waste heat recovery units located within the catalytic cracking unit. A portion of the condensate formed from the steam is returned to the boilers and the balance made up with carefully treated water. The boilers and principal auxiliary equipment are housed and can be operated during a power failure.

A central refinery air supply system is located within the boiler plant consisting of separate air compressors for instrument air which is carefully dried. A separate group of air compressors is provided for maintenance and special services in the refinery. A spare group of compressors provides either instrument or service air under emergency conditions.

The water supply system is a unique feature of the refinery. Drinking water is secured from the City of Sarnia through a main approximately 15,000 feet in length. For process cooling water, the untreated river water which is rarely over 70° F. is used. A seven-foot tunnel connects the shore intake to the main pump house where three vertical motor driven pumps of 8,000 gpm capacity each are installed. This water is delivered through a 36-inch steel main directly to the units. From this main is drawn the water for the steam boilers and processing at the refinery. The process wash water is clarified in a precipitator together with boiler feed water. Motor driven pumps deliver the process wash water in a separate main and the boiler feed is filtered, softened and pumped to the boiler plant. Chlorine for slime control is injected into the 36-inch main beyond the take-off for process water. All this equipment is in a separate building.

For fire protection, in addition to the chemical apparatus, there is a separate loop main with fire hydrants throughout the plant. An electrically driven pump in the water treatment building draws water from the 36-inch main and boosts the pressure to the required limit. As a standby in case of power failure there is a vertical diesel engine driven pump at the main pump house.

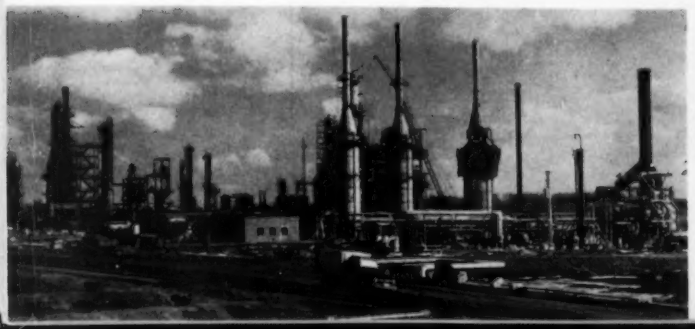
A study of the water supply reveals that there are five different water supplies in the refinery: i.e., city domestic, river cooling water chlorinated, process water clarified, boiler feed filtered and softened, and fire protection raw river water.

A feature of the cooling water supply is a 250,000 - imperial - gallon elevated water tower which will maintain a constant pressure on the cooling water lines in the refinery and afford additional protection in emergencies.

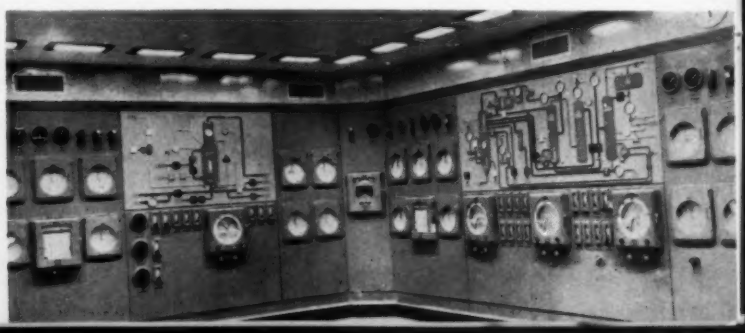
The drainage system is unique in that it consists of separate sewers for the following: sanitary sewage carried to a septic tank and double drained sand bed; storm water to the river with provision for low flows diverted to the waste treatment plant; cooling water subject to oil contamination to the waste treatment plant—cooling water with no oil contamination hazard to the river. Thus there are four separate sets of sewer drains, ranging in diameter from 12 to 48 inches.

To remove any waste oil from the various streams, a new type of waste treatment plant was built. This plant con-

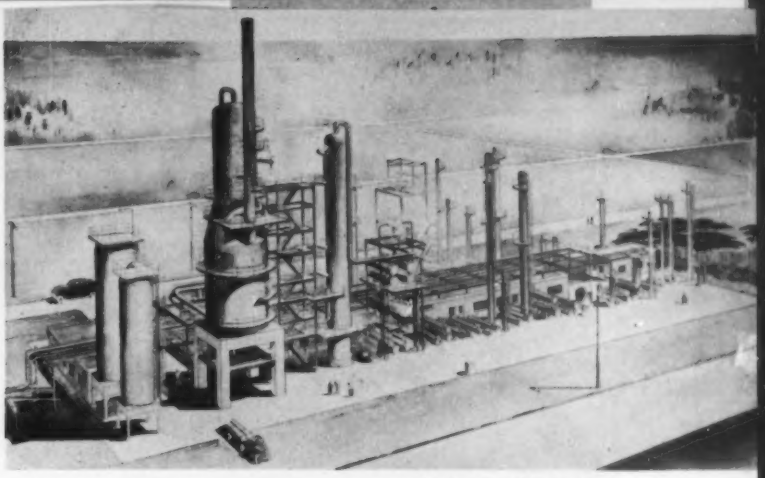
The three key installations. From the left, cat cracker, crude distillation group and Platformer.



Control room of the catalytic cracker, gas recovery, and catalytic polymerization units.



The crude distillation unit under construction, as seen from the top of the cat cracker.



Engineer's sketch of cat cracker and auxiliary units.

sists of two circular concrete tanks 80 feet in diameter and 8 feet in depth with conical shaped bottoms. Drainage water containing waste oil is delivered to a riser pipe with a baffle in the center of the tank, from which it flows radially to a circumferential weir after passing under a six-foot-deep baffle plate which is also circumferential. The waste oil floats to the top of these tanks and is decanted off the surface by mechanically adjusted decanters and pumped up to the slop tanks for recovery.

Undiluted viscosity broken crude oil residue produced in the crude distillation unit is normally used as fuel oil by the refinery itself. The oil is pumped by a loop pipe line to insure continuity of operation. A further precaution includes the instantaneous service of a spare pump in the event of failure of the main pump.

Oils which are reclaimed and are not suitable for processing are delivered in a separate pipe line for disposition in the boiler house.

A gathering system of pipe lines accumulates the residue gases from the process units and from Dow Chemical and delivers them under pressure to the process units and boiler house for additional heat. Excess gas is automatically discharged to the flare stack where it is burned.

Adequate handling facilities are provided for the various catalysts, treating chemicals, inhibitors, dyes, anti-knock fluid and dryers required for the refinery with minimum manual effort.

The principal chemical used is caustic soda which, being soluble in water, is especially treated in a novel process utilizing carbon dioxide from the catalytic cracking unit. The treatment converts the spent caustic to an oily liquid which is carefully separated and burned in boilers and the remaining caustic is changed to a harmless salt.

All electricity for power and lighting is supplied by the Hydro-Electric Power Commission of Ontario. A dual or "looped" system feeds the refinery with power made available from three independent sources for maximum reliability.

A substation transforms the high voltage to more suitable voltage before distribution in an underground duct system. Distribution is radial and not looped to the various users. The substation contains a dual set of transformers which are interlocked to permit automatic changeover from one transformer to the other in the event of failure of one. The power received at the area of use is further reduced in transformers to the voltages required by the equipment or lighting. The system is completely explosion proof in all areas considered hazardous. A small emergency steam turbine-driven generator installed in the boiler house provides shadow lighting and power to operate control instruments in the refinery in case of emergency.

Relief valves are provided on all pressure vessels. These are piped to a flare stack and any light vapors burned automatically. Heavy oil vapors and liquids are piped to a separate quench tower which liquefies the vapors automatically by means of water. A pump returns oily water to special tanks for oil recovery.

A complete pipe loop system encompasses the refinery with water for fire fighting. Water is made available under high pressure from a motor driven pump operating from the elevated water tank and the cooling process water system. A spare diesel-driven fire pump supplements the main pump. Adequate foam systems are installed for the protection of all tanks and to handle fires within the process units. Portable chemical fire extinguishers are located at strategic points in the various buildings or steam snuffing is provided. Complete water spray systems are installed in the anti-knock fluid storage building. Buildings not otherwise protected are sprinklered.

A fire station building houses a mobile fire engine, foam trailer carts, a patrol jeep, hose, and drums containing foam liquid compound and dry chemicals. For convenience, an auxiliary building at the opposite side of the refinery supplements the hose and chemical contents of the fire station.

All important points of the refinery are closely knit together by means of an automatic telephone communication system which permits contacts to the outside. Separate systems to Dow and Polymer permit direct communication with strategic operating points in the refinery. In the event of an emergency an independent network permits transmission of instructions to personnel at selected points.

A complete laboratory equipped with the most modern type of devices permits rapid and precise analysis and control of the products made.

The refinery is laced with roads and access ways. Roads are elevated to permit the crossing of pipe lines which are laid on specially designed and patented supports near the ground. A railroad siding services the refinery shipping and materials requirements.

Prior to the commencement of operations, Canadian Oil Refineries Limited established an objective training program for its new refinery operators. Preliminary discussions were held with the contractors' engineers concerning the various processes. This was followed by actual observation of the operation of similar processes in refineries both in Canada and the United States.

The remaining step-by-step program included: intensive blackboard instruction, study of the flow diagrams with attendant motion picture films, additional discussions with contractors' engineers concerning the written operation instructions, detailed study of all mechanical and control features in the entire refinery, and participation in preliminary and eventually full operation of the various components.

Government and petroleum industry leaders estimated last year that Canada needs 100,000 barrels per day of additional refining capacity. Canadian Oil's new plant will supply one-fifth of that deficiency. As the refinery goes on stream, indications are, therefore, that its entire output from the first full-production day will be required for civilian and defense uses.

Purchase of land for expansion even before levelling of the adjoining refinery site began was an application of Canadian Oil's policy of long-range planning. In short perspective, the firm's feat in doubling its capital assets in a little more than two years may foreshadow new construction and expansion projects already under study.

Shale shakers often freeze during the Canadian winters, causing mud to flow over without leaving cuttings behind. The worker pictured is adjusting a shaker at 30 degrees below zero. Imperial Oil Ltd. photo.

SUB-ZERO WEATHER COMPLICATES WELL SERVICING OPERATIONS

BY A. R. POTTER*

WINTER operations in Canada present many and varied problems which must be contended with to keep the wheels of the oil industry in motion at the formidable pace for which the industry is noted. For not only are transportation difficulties enhanced, but the added strains on equipment and manpower intensify as in a geometric progression. It is interesting to observe the results of the U. S. Army in this connection, which has arrived at the following conclusion with respect to the efficiency of combat troops in sub-zero conditions: at 20° below it takes twice as many men twice as long to do half as much. Another rule of thumb is that a man loses two degrees of efficiency for every degree below zero.

Since the impact strength of steel decreases sharply with decreasing temperatures, shock and impact loads at these temperatures impose terrific stresses on equipment and materials. Also, extremes of cold impose a greatly increased bearing friction and lubricant viscosity load on moving parts and motors. It is common practice to change lubricants in both spring and fall to provide properly selected summer and winter grade lubricants. The sum total of all this is that winter operations are time consuming, costly and hazardous. Only sheer grit, determination and ingenuity of the oil industry personnel make such operations possible.

It is almost impossible to carry out drilling operations without a steam boiler on the location. Water for mixing mud, cementing, etc., is kept from freezing by the constant use of steam. All flow lines not in use are carefully drained and blown down with steam so as to be available when required. Similarly, mud pumps are thawed out by injecting dry steam.

Cementing operations require almost double the time and labor as compared to that in above-freezing temperatures. On arrival at a drilling well, the equipment is thawed out and set up. Steam is injected throughout the pumps and manifold system until continuous flow is established and all valves are working freely. Pumps must be turned over with wrenches to insure that their motion is not being restricted by ice accumulation.

Mixing water when it reaches the truck

**Engineer, Halliburton Oil Well Cementing Co., Ltd., Calgary.*

A blow-out in winter weather in Canada may burden the derrick with ice as was the case at Tangent, Alberta, last year.

is almost always at freezing temperatures and fluid only because it is moving. If pumps are not warm, the valves and pistons would freeze immediately. When steam is available, the water is heated in the displacing tanks prior to circulating to the pumps. Propane flame throwers are standard equipment for winter operations and are utilized extensively. While mixing, the flame thrower is kept directed on the mixing bowl to prevent the jet from freezing off.

Often at the completion of jobs it has been observed that two-inch discharge lines may have only a three-quarter to half inch hole through frozen cement inside them. In cold weather the running of measuring-lines in conjunction with casing jobs is extremely difficult. Ice accumulation in and around the stuffing box and staff assembly renders its use impracticable, consequently this service is seldom utilized. At the completion of a cement job, the pump and all lines must be thoroughly drained and all valves left open to prevent damage and breakage of equipment by freezing. Lack of the proper precautions has cost tremendous sums of money to replace expensive high pressure valves etc. Successful cementing jobs have nevertheless been carried out with temperatures as low as 68°F. and in bitter cold winds of gale proportions. Undoubtedly even more severe conditions were experienced at Fort Norman in the North West Territories during the last war.

Recently interest has been aroused as to the effect of the temperature of mixing waters on the ultimate strength and setting characteristics of the resulting cement slurry. While nothing appreciably significant was established from experiments conducted on a particular set of mixing waters at various temperatures down to 32°F., certain peculiarities were observed. It is anticipated that further work along these lines will be carried out to safeguard against and minimize the hazards of sub-zero cementing operations. In a few isolated cases, cement failures have been traced somewhat indirectly to temperature conditions. Small bodies of water such as sloughs, etc., used for mixing water in cementing may be disastrous during the winter season. As ice forms over them, the organic material and acids settle out and concentrate in the water below the surface of the ice. In one particular case this resulted in a slurry which would not set up, consequently a cement failure resulted. Such occurrences warrant continued research, since the elimination of expensive remedial work represents a cash saving to the operators.

The logistics problem in western Canadian oil operations is complicated also by the tremendous distances to be traversed in supplying and servicing wells. The search for oil has laid open a vast expanse of territory. Oil activity is spread out from the Northwest Territories and northern British Columbia to the United States-Canadian border and from the Rocky Mountains to the Province of Manitoba. It is not at all uncommon for a vehicle to be despatched from 500 to 1,000 miles to do a cement job or test a well.

In spite of the elements, almost every Halliburton service available in the United States is also available in Canada. The first Hydrafrac job performed in Canada was completed successfully at a temperature of —38°F. accompanied by a wind of 20 mph. Special steam coils were constructed and installed in the displacing tanks of cement trucks. By the use of steam and by circulating constantly, the required temperature of the kerosine was attained and maintained. Moreover, several Hydrafrac jobs have since been accomplished under various conditions, some being as far as 800 miles from the main camp in Edmonton. The major portion of these Hydrafrac jobs has thus far been very successful and indications are that the process may be widely employed.

One of the more well known highlights of the relatively young oil industry in Canada was the Atlantic 3 blowout. On March 8, 1949, the well blew wild but was brought under control within a couple of days. Several days later, however, terrific gas pressures cratered the earth around the 300 feet of surface casing and gas began escaping. Six cement pump units forced almost 1,200 sacks of cement, 1,000 sacks of cal seal and other chemicals into the well in an unsuccessful attempt to kill it. Later, ten thousand pounds of feathers, twenty-eight tons of redwood fiber, and fifty-five tons of cotton seed hulls, balsam fiber and mud were pumped into the hole to no avail. Two directionally drilled relief wells were started meanwhile, and water was being injected through a well close by to alleviate the situation. From 10,000 to 14,000 barrels of oil were being produced daily from the wild well while production was restricted from other wells in the field. Six months later, as the final stages of killing the well were to be completed, fire broke out in one of the most spectacular blazes of Alberta oil history. Within a few days, however, the fire was doused by water injection through the two relief wells.

Another rather interesting blowout occurred at Tangent, Alberta, in the early part of 1951. While pulling a tester, the well was swabbed in and blew out of control. Considerable salt water was being produced with the gas flow, resulting in the derrick's becoming almost entirely sheathed in ice. The major portion of this ice was removed by jetting with water from a pump truck. Due to the adverse weather conditions, no further work was done for a few weeks, after which the blowout preventer was changed and the well killed by heavy mud and cement plugs.

The Canadian oil industry had the distinction of pumping to place the world's tallest single-stage shoe-to-surface column of cement (up to that time—1949) in the Pincher Creek field of Alberta for

Winter drilling with a portable rig showing weather protection for machinery and derrick man. Photo by H. Pollard, Calgary.

the Canadian Gulf Oil Co. when 5,500 feet of 9⅝-inch casing was set in 12¼-inch hole at Gulf's Walter Marr No. 1 well. The production string was set from approximately 12,000 feet and cemented up into the base of the 9⅝-inch casing. Highly corrosive gas from the producing zone renders this protective feature extremely important. Only through the accumulation of experience gained in such cementing operations throughout the United States and South America was it possible to work out the technique which was responsible for this successful cementing of 5,500 feet of casing from shoe-to-surface in one single stage.

Five cement trucks were used for the cementing operation. The 2,300 sacks of high temperature slow set cement and 1,900 sacks of Canadian Portland were distributed between the trucks for mixing. The first 3,900 sacks of cement were mixed at approximately 13.5 pounds per gallon and the remaining 300 sacks at 15 pounds per gallon. This prevented the formation of a slurry too viscous to pump resulting from water loss to the formation. The discharge lines from the trucks were connected to a four-inch manifold which was in turn connected to a five-inch standpipe and four-inch steel hose. The weight of the displacing mud was increased to ensure constant circulation as the cement column was pushed up the annulus. The circulating pressure was 1,000 psi and leveled off to 750 psi after the pumps were stopped. Total time for the overall operation was three and one half hours, two hours and a half for mixing and one hour for pumping the plug to bottom.

Since this particular job, the production string for the above well has been set and the intermediate and production casing strings set on another. Also at this time, more wells in this area with similar unusual and difficult cementing conditions are in the offing.

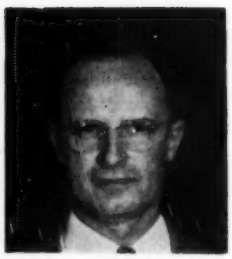
Raising temporary radio aerial for seismograph party at minus 50° F. Imperial Oil Ltd. photo.

GEOPHYSICAL ACTIVITY IN WESTERN CANADA

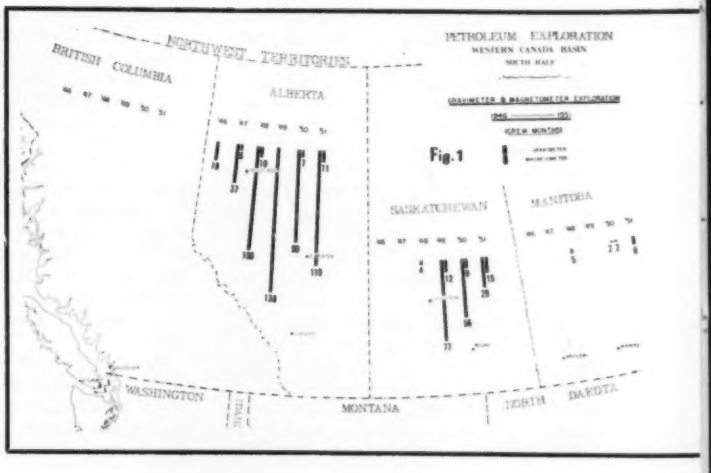
IN AN ILLUSTRATED address before the recent annual meeting of the Society of Exploration Geophysicists at Los Angeles, H. M. Houghton, geophysical supervisor for Amerada Petroleum Corp. at Calgary, presented a series of slides showing the trend of activity in Western Canada since the discovery of Leduc. Several of the slides are reproduced here through the courtesy of the author.

Fig. 1 shows exploration by gravimeter and magnetometer during the period from 1946 through 1951. The length of the bar in each case represents the number of crew months in each province. It will be noted that there has been no activity using either of these methods in the province of British Columbia and only a very small amount in Manitoba. As might be expected, Alberta has had substantially more gravimetric and magnetic exploration than has the province of Saskatchewan.

Fig. 2 shows seismic activity in Western Canada, also expressed in terms of crew months. Seismic exploration in British Columbia did not start until 1948, grew only slightly in 1949, decreased in 1950, and increased again in 1951 to 15 crew months. It will be noted that the bar scale for seismic activity has been reduced by a factor of one to five as compared to the bar showing magnetic and gravimetric activity on the first chart. Here again Alberta has had much the greatest amount of geophysical exploration. In 1946 there were 107 seismic crew months in the province, growing to 146 crew months in 1947 with a very substantial increase to 405 crew months in 1948, and continuous growth during the last three years to a maximum of 1,175 crew months in 1951. The sharpest



H. M. Houghton, geophysical supervisor, Amerada Petroleum Corp.



Seismograph crew train powered with a crawler type bulldozer. Sled trailers contain equipment and living quarters. Runners are made of 4-inch tubes. Trains of this type move freely over muskeg and bush in winter months. Imperial Oil Ltd. photo.

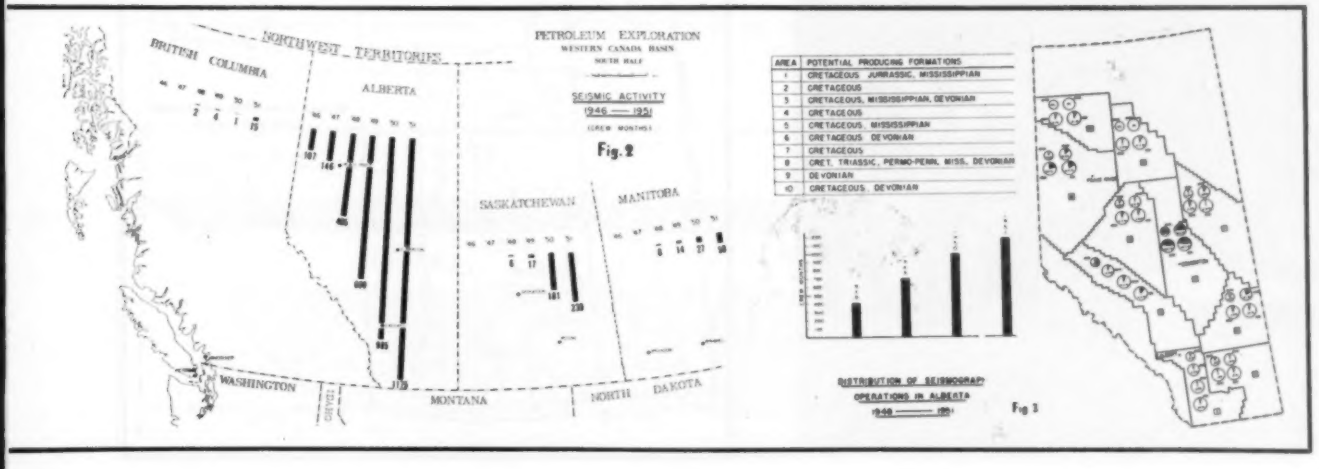
percentage growth occurred, naturally, after the discovery of the Leduc oil-bearing reef in 1947.

Saskatchewan's geophysical activity for the period under consideration began in 1948 with six crew months, growing to 17 crew months in 1949, increasing sharply in 1950 to 181 crew months, and increasing further to 239 crew months in 1951.

With two small exceptions, no seismograph exploration work had been done in Alberta more than 50 miles north of the provincial capital at Edmonton prior to 1948. The area in the central and southern part of the province was covered by seven of the larger oil companies and probably represents over 90 percent of the coverage prior to Jan. 1, 1948.

Fig. 3 shows outlines of areas studied in Alberta with the potential producing horizons listed in the upper left corner. On the map, the size of the circles represents the total seismograph activity in the province expressed in terms of crew weeks with the black portion of each circle representing the percentage of the activity in each of the areas.

Area No. 6, in which Edmonton lies, nearly in the center, has had by far the greatest amount of activity in the whole province. Percentage-wise this area's peak was reached in 1949: 51.6 percent of the total activity in the province. Activity dropped off slightly to 45.7 percent in 1950 and to 45.3 percent in 1951. In the northwestern part of the province, Area No. 8, which includes the town of Peace River, had the second largest concentration of seismic activity. The bar graph to the left of the map of the province shows the growth in total seismic activity in the province in each of the four years.



Auger drill especially designed for drilling shot holes in the far north requires no drilling mud. Imperial Oil Ltd. photo.

Supplies for operations in the north country are often brought in by plane. Pictured here is an Imperial Oil "Beaver" which has landed on the Wabaskaw river.

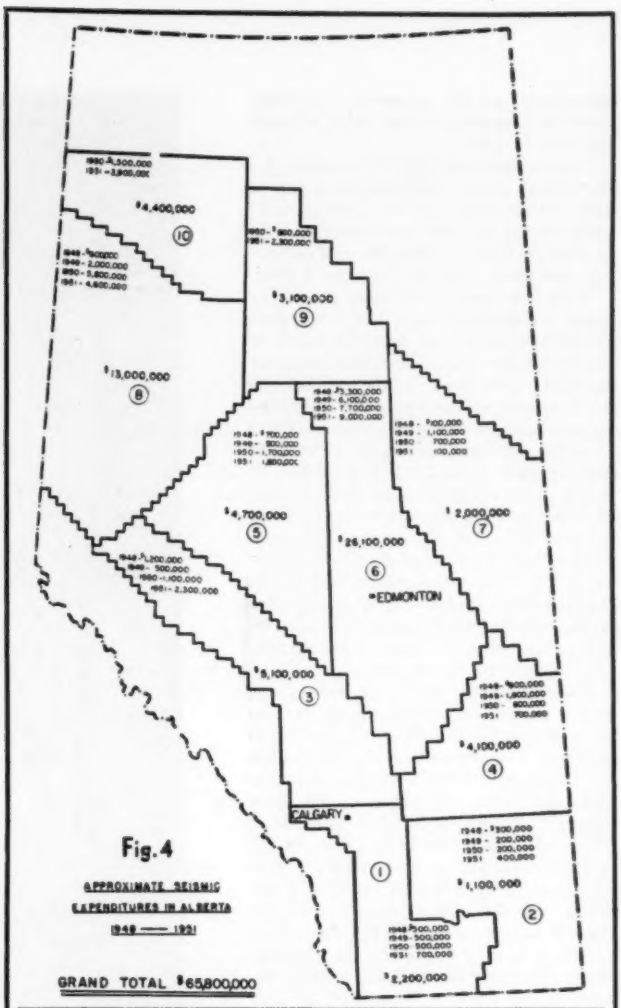


Fig. 4

APPROXIMATE SEISMIC EXPENDITURES IN ALBERTA

1948 — 1951

Fig. 5

Imperial Oil headquarters at Peace River keeps radio circuits open from seven AM to 11 PM to communicate with seismograph crews in the field.

Evening entertainment for seismograph crew members in the north country. Imperial Oil Ltd. photo.

Fig. 4 shows the estimated cost of seismic activity in each of the ten areas by years, with the larger figure showing the total estimated expenditure for the four years. In Area No. 6, the so-called "fairway" surrounding Edmonton, a total of $26,100,000 was spent during the period from 1948 through 1951. In Area No. 8, in the vicinity of the town of Peace River, the expenditure for the four years amounted to $13 million, or nearly half the amount spent in Area No. 6. The estimated grand total for the province for the four years was $65,800,000. The costs were based on average monthly operating costs furnished by seven of the major oil companies doing geophysical work in the province. In the bush areas such as Nos. 5, 8, 9 and 10, individual monthly operating costs were increased over the prairie areas Nos. 1, 2, 4, 6, and 7 by the amount of camp operating costs and bulldozing expense. Average monthly costs in the prairie areas was $17,000 per month while the average cost per month for a bush crew was $29,000.

Fig. 5 shows the network of bulldozed "supply roads" in northwestern Alberta and represents a total mileage of 3,350 at an estimated expenditure of $2,500,000. The "supply roads" are, of course, considerably more expensive than the ordinary bulldozed trails which are used for seismic exploration. The cost of the supply roads was approximately $750 per mile. Seismograph bulldozed trails averaged $300 per mile.

In a comprehensive series of diagrams and photographic slides, Mr. Houghton illustrated the difficulties which are encountered in conducting reconnaissance work in the Peace River and other northern areas where the muskeg does not provide a safe footing for necessary equipment in the summer. As a result, the geophysical work is largely done in subzero weather.

Fig. 6 diagrams the type of reinforcement which is needed to carry heavy vehicles on the normal ice over the Peace River. It illustrates the need for additional support due to the drop in the water level of the river after the first surface ice has formed. Logs are laid across the trail and the space between them is packed with snow and sawdust. Water is then pumped from the river on top of the logs, freezing the whole into a solid mass. This type of bridge was used to transport a D7 Caterpillar bulldozer across the Peace River after the ferry had stopped operating at the town of Fort Vermillion.

Mr. Houghton has been with Geophysical Research Corp., a subsidiary of Amerada, most of the time since 1929, two years after his graduation from the Massachusetts Institute of Technology. He has acted as chief observer on seismic parties, party chief and geophysical supervisor. He was away from Amerada for three years from 1943 to 1946 as geophysical supervisor for Tide Water Associated Oil Co. at Houston, and on the Manhattan Project in charge of earth shock measurements of the first atomic bomb at Los Alamos and at the Almagordo bombing range in New Mexico. On the completion of this work, he did contract geophysics with Geotechnical Corp. in southeast Alberta, Wyoming and Utah.

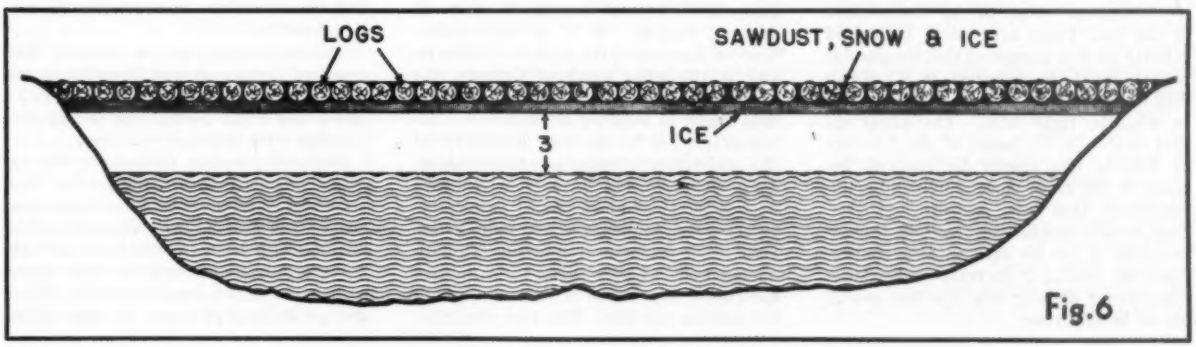
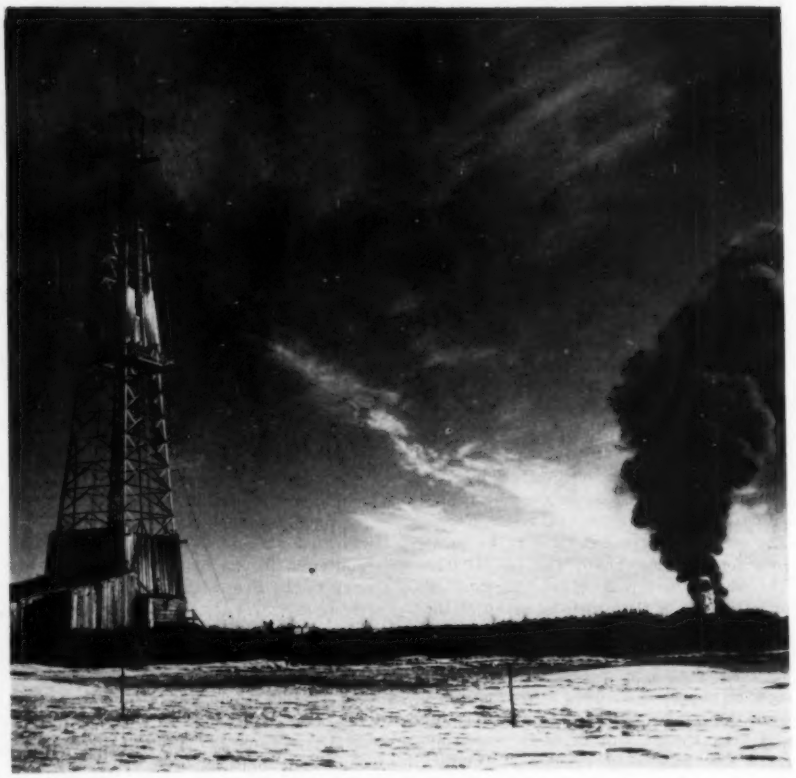


Fig.6

JET BIT DRILLING

By A. Scovil Murray

A. Scovil Murray, who is a drilling engineer with Imperial Oil Ltd., started work with that company as a roughneck in 1943. On graduation from the University of Tulsa in 1948, he joined the Venezuelan Atlantic Refining Co. and was engaged as a field petroleum engineer associated with drilling, production, and reservoir work. After completing his two-year Venezuelan contract, he returned to Imperial Oil Ltd. to set up a new section primarily concerned with drilling engineering studies and problems.



Burning off oil-contaminated drilling fluid while completing a well in Western Canada.

THE REMARKABLE penetration rate advantage obtained by contractors in the Gulf Coast area using high fluid velocity jet bits suggested that comparable results could be obtained in Canadian drilling operations. A test was conducted to evaluate these bits. The Leduc oil field located in the heart of the Province of Alberta was chosen for the test because of the large amount of drilling information that was already available. Test results conclusively showed the superiority of jet bit drilling over conventional bit drilling in increased penetration rates, fewer drilling bits, and less overall bit on bottom time.

The Leduc oil field, discovered in February 1947, is located in the Province of Alberta, Canada. It is 15 miles southwest of Edmonton, the capital of Alberta, and is 160 miles north of Calgary, the second largest city in the Province. This field ranks as a major oil discovery. Its topography is in no way indicative of the underlying structures which embody some 42,000 proven acres from two producing zones having estimated recoverable reserves well in excess of 200 million barrels. The field now comprises 800 producing wells. Under present government allowables these wells are producing 40,500 barrels per day. The two producing zones, commonly known as the D-2 and D-3, have yielded approximately 39 million barrels.

The stratigraphic section drilled is composed of Cretaceous and Devonian series. A generalized geological section (Fig. 2), shows the eight formations encountered together with principal members.

Upper Cretaceous drilling to the top of the Viking, approximately 3,500 feet, encounters loosely consolidated sandstones, shales, and coal seams. Glauconitic and bentonitic materials distributed throughout the formations hydrate with water, accomplishing a normal dispersion. There are no drilling problems in this section

IN THE LEDUC FIELD

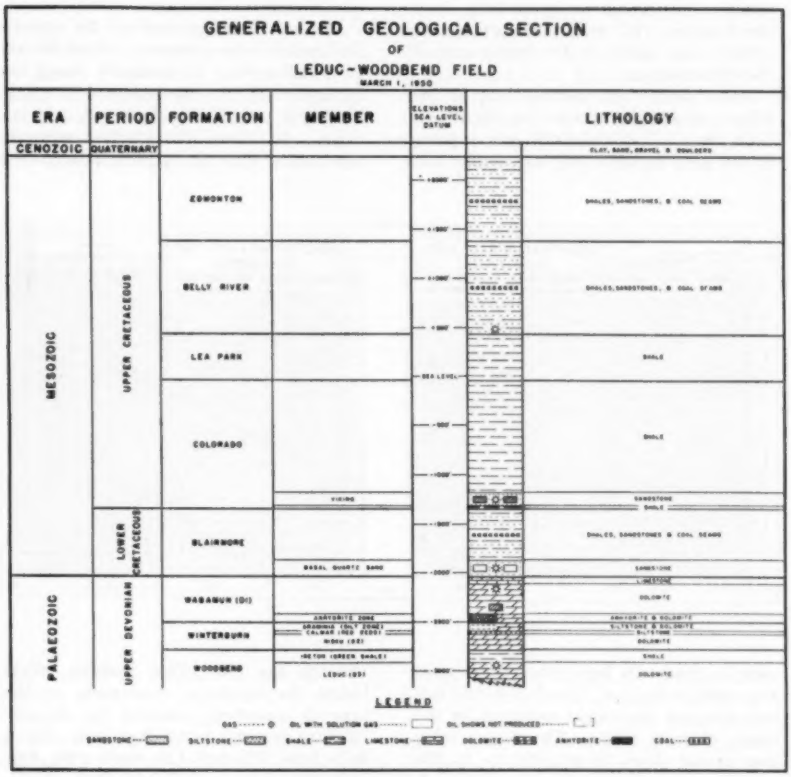


Fig. 2. Geological section and lithology of Leduc field.

where penetration rates are the fastest. Drilling rates fall perceptibly in the dark gray shales of the Viking member due to the presence of interbedded chert and glauconitic sandstones.

From approximately 3,500 to 4,100 feet the Blairmore formation, consisting of shales composed of carbonaceous and coaly materials, is easily drilled. The base of the Blairmore consists of a basal quartz sand series composed of hard sandstones with minor amounts of chert. This section is drilled at a low rate of penetration. The Upper Devonian section consists of a dolomitic limestone known as the D-1, anhydrite, siltstone, and a silty shale, often referred to as the Red Beds. This is easily drilled with penetration rates approximating ten feet per hour. Considering the field as a whole, formations are easily drilled with high penetration rates. The lost circulation hazard is common to the field. Vuggy, fractured, and sometimes cavernous dolomitic limestone of Devonian age causes loss of circulation varying from a few hours to over fifty days lost drilling time. In general, lost circulation is common to the entire field though its degree of seriousness is very spotty.

Drilling practices used in the Leduc field are extremely variable. Rig equipment, however, is fairly well standardized. Slush pumps range in size from 6¾ x 12 inches to 7¼ x 15 inches. The horsepower delivered to these pumps varies from 165 to 275. One 7-inch drill collar or three 6¾ inch drill collars, or their equivalent, are commonly carried next to the bit for weight. Drilling masts capable of handling threbles have almost entirely replaced the conventional derrick.

Two Emsco G-42 rigs owned by Imperial Oil Limited were moved into the field in April, 1950. In the elapsed time to August, 1951, twenty wells representing 100,800 feet of hole were drilled. The average penetration rate attained per well

was 13.5 feet per hour, footage per bit 166.2, and bit cost per foot drilled $1.02. A detailed study of the penetration characteristics of each well and the drilling methods used indicated that few conclusions were being made as experience was gained. Rotating speed, weight carried, and volume pumped changed with each well for every geologic section penetrated. Seventeen types of drilling bits were used. No one type appeared to be consistently used in any formation. This investigation indicated the necessity of improving drilling practices so that faster penetration rates and resultant lower costs could be realized.

High fluid velocity jet bits are now being sold by many manufacturers. The ordinary conventional bit has been slightly changed to realize this revolutionary idea. The shank has been extended and the conventional watercourses blanked off. Watercourses were placed in the bit so that high fluid velocity drilling mud was directed at the bottom of the hole one inch inside the diameter of the hole. This is compared to conventional bit hydraulics in which low velocity fluid impinges on the teeth of the cone and is thrown radially against the sides and to the bottom of the hole. In a jet bit, drilling fluids at a high velocity are forced through tungsten carbide nozzles placed in the end of the watercourses. Cuttings are immediately carried away so that the teeth are always in contact with new formation. In the softer formations it is felt that the jetting action actually disintegrates the formation and facilitates bit action.

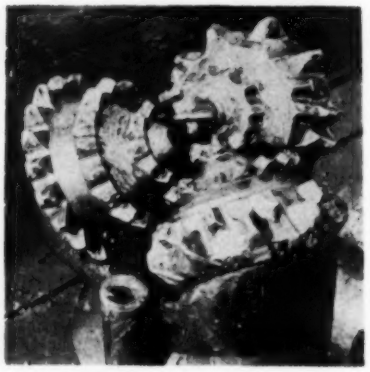
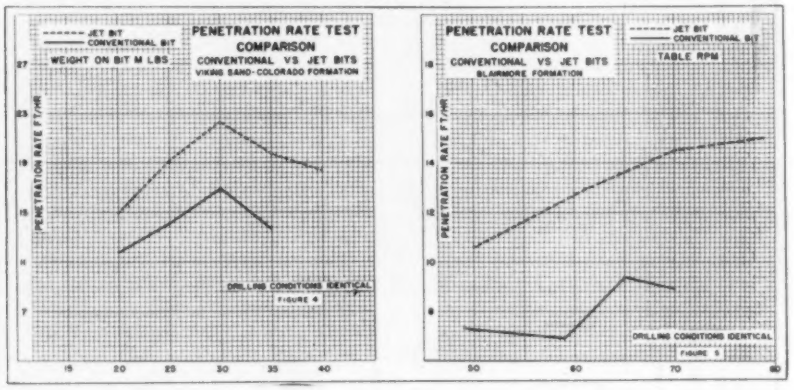


Fig. 3. Composite jet bit.

At the time of the test, integral jet bits were not available in Canada. A special sub which was common to Gulf Coast jet bit drilling operations was used. This made possible the conversion of conventional bits to jet bits. The sub was 7¾ inches OD by 21¼ inches long. (Fig. 3.) Three watercourses of one inch extra heavy seamless pipe start from the inside about eight inches from the top of the box and come through the wall of the sub. These are welded to the shanks of a tricone bit which is made up on the bottom of the sub. Tungsten carbide nozzles are brazed in the ends of the watercourses which themselves project about three-quarters of an inch beyond the shroud of the bit. Precision machine work was required to make the watercourses line up in the correct position between the cones of the bit. This often required taking 20 or 30 thousandths of an inch off the shank shoulder of the bit at one extreme, or adding hardened steel spacer rings at the other extreme. In order to effect a pressure tight seal for the watercourses which are removable from the sub, two "O" ring packings are inserted in a sleeve at the upper end of the watercourses.

There were few modifications to existing rig equipment used on the Emsco G-42 rig. A National C-350 power pump driven by a Superior P.T.D.-8 engine was used to maintain high circulating rates and nozzle velocities. Ten 7-inch drill collars provided the weight required for the range of tests made. The rotary table was geared down to provide up to 275 revolutions per minute maximum. A special 21-foot drill collar changeover sub was used between the 7¾-inch OD bit sub and the 7-inch drill collars. Fishing flutes were made in the top five foot section as a safety measure. A short double pin connection between the jet sub and the 7-inch drill collars was considered unsafe for good operating practice. A Geolograph was used for accurate recording of penetration rates as well as a means of correcting excessive drilling times when hard sections were encountered in the formation. An engineer was present on all tours to record penetration rate and equipment performance data. This included table speed, weight on bit, nozzle velocity, circulating pressure and volume, pump speed and hydraulic horsepower, engine rpm's and brake horsepower, and a plot of each bit's performance while in use.



Prior to the field tests, considerable work was done in computing the size of liners and the horsepower required under all conditions expected. The term "high fluid velocity" is used to describe the jet bit. Computations were made to establish those conditions which would make possible the highest fluid velocity at the nozzles. Since mud volume is the determining factor for nozzle velocity, maximum volumes were computed for many sizes of liners used with the pump. Secondary consideration was given to pressure, hydraulic horsepower, and brake horsepower, only as those factors were influenced by the manufacturer's recommendations on the pump and engine used.

Pressure drops throughout the circulation system were computed. These included consideration of pressure losses associated with the surface mud line system, drill pipe, drill collars, bit, and annulus. Of these, the greatest pressure loss occurs when the drilling fluid passes through the bit. This analysis established the following conclusions on the type of equipment required for the circulatory system: 4-inch flow lines, 4-inch kelly hose, 2⅞-inch I.D. wash pipe, 4½-inch drill pipe, and 7-inch drill collars. Pressure drops across the bit were controlled to the amount of horsepower available by varying the size of liners in the pump and nozzles in the bits.

With this preliminary work completed, only field testing could complete the evaluation of jet bits. A twin location in which two wells were drilled, one to the D-3, the other, approximately 100 feet away, to the D-2, was selected for the test. In this manner the same rig and crews were used for both holes. This decreased the possibility of error or deviation from test procedure associated with personnel and equipment. The use of a twin location also enabled the optimum comparison of drilling data since there was no change in the composition of geological sections. One well was drilled with 9″ conventional bits, one with 9″ jet bits.

An evaluation of the factors affecting penetration rate was the most important analysis forming a part of the experimental procedure of the first two test wells. These included: 1) Weight on bit, 2) Rotary table speed, 3) Circulation rate, 4) Nozzle velocity. The analysis was necessary to enable a complete understanding of the drilling characteristics of the bit, and drilling conditions common to the field. Penetration rate tests were conducted with each new bit from the Viking sand, approximately 3,500 feet, to the top of the D-2, approximately 5,100 feet. The procedure followed in these tests was similar to that commonly used in the industry. All of the factors affecting penetration rate but one were held constant while that factor was varied over a range of conditions. The analysis showed that the drilling rate was directly proportional to each factor. When all were evaluated in this manner the optimum drilling conditions were established for each formation.

quainting new personnel with jet bit drilling characteristics and test procedures. Based on the data obtained from the previous tests, the optimum drilling weights, table speeds, circulation rates, and nozzle velocities were used. Capitalizing on the previous tests in this manner, the experiment was set up to establish the best results that could be expected using equipment that was common to all four tests. Penetration rate curves were plotted for each bit while in the hole. When the slope of the curve fell below a predetermined minimum point based on the penetration rate test results, the bit was pulled.

Throughout the four tests seven different data sheets were kept to record drilling characteristics every 25 feet. These included: penetration rate data, pump record data, P.T.D.-8 engine data, drilling mud properties, drilling conditions (e.g. table rpm's, bit weight, etc.), record of singles added, and a continuous penetration rate curve for the well.

TABLE 1

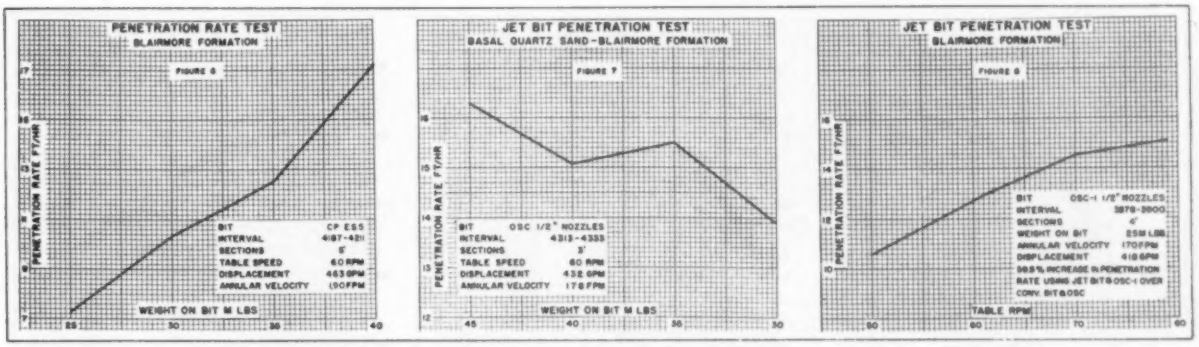
COMPARISON OF DRILLING TIME, 9" HOLE DRILLED FROM SURFACE CASING TO TOP OF D2

	FOOTAGE DRILLED	NO. OF BITS USED	DRILLING TIME HOURS	TIME TO 9" JET TEST	DAYS IN DAYS	AVERAGE PENETRATION RATE FT/HR
AVERAGE 17 WELLS DRILLED BY EMSCO RIGS	4730	32	336	191	80	14.0
CONVENTIONAL BIT TEST	4730	30	271	126	53	17.4
1st JET BIT TEST	4730	* 31	222	77	32	21.3
2nd JET BIT TEST	4650	** 24	162	17	07	28.7
3rd JET BIT TEST	4743	*** 28	145	—	—	32.6

* 4 extra bits were used in drilling and reaming under gauge hole.

** Includes 2 conventional bits used to drill Cretaceous for testing program.

*** 6 bits drilled on iron. This accounts for increased number of bits used.



This resulted in a comprehensive understanding of Leduc drilling characteristics.

Figures 4, 5, 6, 7, and 8 are indicative of some of the results obtained by this analysis.

When drilling the first two wells no attempt was made to capitalize on the information gained from the penetration rate studies or other data. Drilling conditions were held similar for comparative purposes. At the conclusion of these wells a superiority of jet bits over conventional bits was evidenced. Many questions, however, remained unanswered. Foremost of these was the bit program. On the first two test wells the bit selection and drilling time was a decision of the toolpusher and drillers. This was based on their previous experience in the field. The penetration rate test data indicated that this program could be improved. A second twin location was allocated to make final evaluation of high fluid velocity jet bits. Unfortunately the rig used on the first two tests was not available for further tests. This introduced the problem of ac-

Figures 9, 10, and 11 are plots of data kept for an analysis of displacement, engine brake horsepower, and pump pressure. Figure 12 is a plot of the general drilling conditions maintained on one of the jet bit test wells. Figure 13 shows the optimum penetration characteristics attained on the third test location.

The jet bit test experiment indicated that a progressively better penetration rate was being obtained for each well. This was evidenced by a general shifting of the penetration rate curves to the left. (Fig. 14.)

The optimum overall jet bit penetration rate from below surface casing to the top of the D-2 zone was achieved on the last well. This was 32.6 feet per hour. The average rate obtained in the same interval using conventional bits was 14 feet per hour. This represented an increase in rate of 131 percent for jet bits over conventional bits. Average bit on bottom drilling time was reduced from 336 hours for conventional to 145 hours for jet bits (Table 1). This represented a considerable dollar saving, using a rig operating cost of $40 per hour. A drilling rate advantage was gained by the jet bits in every geological section (Table 2). The experiment indicated that eight less bits could be used in this interval.

In considering a drilling procedure for the field it was determined that high rotating speed (200-250 rpm's) with two 7-inch drill collars resulted in the highest penetration rate down to 4,000 feet. Table speeds should be gradually reduced with depth to 4,000 feet where 120 rpm's is the maximum. As table speeds are reduced, more 7-inch drill collars are added to 4,000 feet, where four are used. Weights in excess of that supplied by the drill collars should not be used. Below 4,000 feet ten 7-inch drill collars are used to total depth. Maximum rotary table speed in this interval should be 70 rpm's. A penetration rate of 204 ft. per hour was obtained with one jet bit when drilling below the surface casing. This was suggestive of jet drag or combination cone and drag bit drilling.

Equipment failures were not too common. Careful inspection was made of drill collars and drill pipe each trip. Some difficulty was experienced due to washed out tungsten carbide nozzles. This was quickly indicated at the surface when the pump pressure fell some 200 pounds. The problem was eliminated in the machine shop where more care was taken to "sweat" the nozzle into its seat with enough brazing material to entirely surround it. Plugged nozzles were at first common. Running in the hole, shale cuttings flowed into the drill pipe, causing a plugged condition when the pumps were started. A float valve was used and found unsatisfactory. A substantial pressure drop occurred across the valve. The problem of plugged nozzles was eliminated through the use of oak plugs which were inserted in the nozzles at surface. These were easily blown out by pump pressure when drilling commenced.

Drilling crews were keenly interested in the tests and many helpful suggestions were made. Drillers at first did not realize the importance of staying at the brake for the full time when drilling. The Geolograph proved to be a useful instrument. It showed the advantage of keeping the required weight on bit when drilling breaks occurred in going from hard to soft sections. Jet bit drilling will accentuate these "breaks" more than conventional bit drilling.

Drilling fluids were used that would enable the lowest viscosity and mud weight to be carried without causing hole trouble. Starting from below the surface pipe, water was used as a circulating medium. Down to 3,000 feet the viscosity was maintained from 32-35 seconds (Marsh funnel) by the addition of water. From 3,000 to 4,200 feet the viscosity was allowed to increase to 40 seconds (Marsh funnel). At 4,200 feet the mud was watered back and "gypped." (Gypsum mud is a calcium-treated mud which was developed in the plains drilling in Alberta. It is converted before drilling the anhydrite section by the addition of plaster of Paris ($CaSO_4 \times \frac{1}{2} H_2O$). Field men call this mud "gypsum" or "gyp" mud. That descriptive is used in this paper). Starch and starch preservative were added to control water loss. Daily additions of starch and preservative were maintained to total depth. Gypsum mud was helpful in obtaining higher penetration rates when drilling with the jet bits. Mud weight was allowed to increase from under the surface pipe to the gypsum breakover point where it is usually around 11 pounds per gallon. When watering back and breaking over, the weight will fall to approximately nine pounds per gallon. This results in better penetration rate, lower pump pressure, and the need for less horsepower. The tests indicated that jet bit drilling penetration rates were higher when low viscosity and weight drilling fluids were used.

A large pump and an abundant power supply were used on the test. This equipment is not common to Leduc field drilling rigs. Rigs operating elsewhere in the prairie provinces using the same equipment can expect comparable results

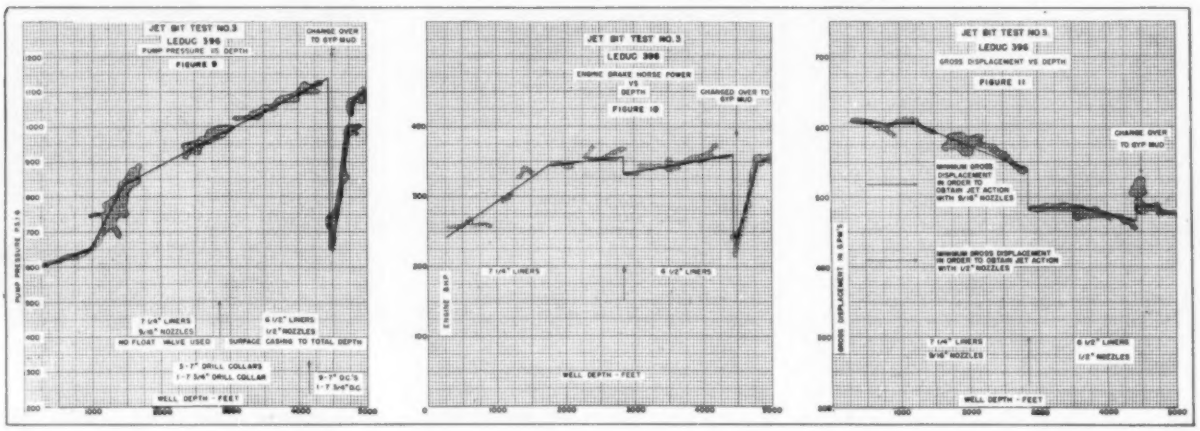
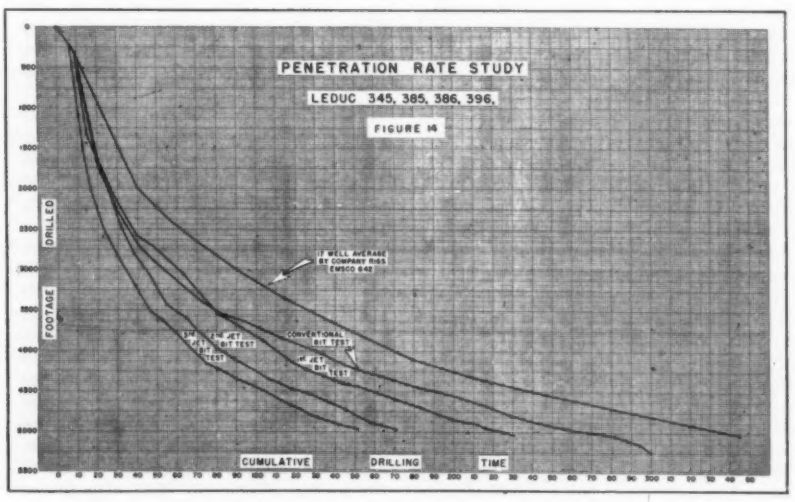

JET BIT TEST NO.3
LEDUC 396
PUMP PRESSURE VS DEPTH
FIGURE 9
CHANGE OVER TO GYP MUD
7 1/4" LINERS
9/16" NOZZLES
NO FLOAT VALVE USED
6 1/2" LINERS
1/2" NOZZLES
SURFACE CASING TO TOTAL DEPTH
5 - 7" DRILL COLLARS
1 - 7 3/4" DRILL COLLAR
9 - 7" DC'S
1 - 7 3/4" D.C.
WELL DEPTH - FEET
JET BIT TEST NO.3
LEDUC 396
ENGINE BRAKE HORSE POWER VS DEPTH
FIGURE 10
CHANGED OVER TO GYP MUD
7 1/4" LINERS
6 1/2" LINERS
ENGINE B.H.P.
WELL DEPTH - FEET
JET BIT TEST NO.3
LEDUC 396
GROSS DISPLACEMENT VS DEPTH
FIGURE 11
CHANGE OVER TO GYP MUD
MINIMUM GROSS DISPLACEMENT IN ORDER TO OBTAIN JET ACTION WITH 9/16" NOZZLES
MINIMUM GROSS DISPLACEMENT IN ORDER TO OBTAIN JET ACTION WITH 1/2" NOZZLES
7 1/4" LINERS 9/16" NOZZLES
6 1/2" LINERS 1/2" NOZZLES
WELL DEPTH - FEET

TABLE 2
PENETRATION RATE ADVANTAGE GAINED BY JET BITS

	AVERAGE PENET RATE 17 WELLS FT/HR	AVERAGE PENET RATE JET BITS FT/HR	INCREASE IN PENET RATE FT/HR	PERCENT OF INCREASE
EDMONTON, BELLY RIVER	60	189	129	215
LEA PARK	32	80	48	150
COLORADO	21	46.4	25.4	121
VIKING	12	19.4	7.4	61.8
BLAIRMORE	11	22.5	11.5	104.5
BASAL QUARTZ	5	11.3	6.3	126
DEVONIAN 1	6	12.2	6.2	103
ANHYDRITE	5	11.6	6.6	132
SILT	4	7.15	3.15	78.8
RED BEDS	5	10.6	5.6	112

Increase in penetration rate drilling from surface casing to top of D2.
Overall .....32.6—14.00=18.6 ft/hr.
Overall increase .....=131 percent



with jet bits because similar geological sections are encountered. Comparable results on a reduced scale should be possible using the equivalent of a 7¼ x 14-inch pump and 300 bhp. Rigs equipped with smaller pumps and less horsepower cannot economically run jet bits which would sufficiently increase penetration rates to enable a payout. Modifications of rig equipment by the use of larger size drill pipe and more drill collars in the two cases just mentioned would greatly increase the penetration rate if jet bits were used. A nozzle velocity of 200 ft. per second is not required, but is desirable, for jet bit drilling. Using smaller pumps, nozzle velocities of 170 ft. per second would show to advantage in Leduc-type drilling. Tests have indicated that more bit weight can be used without danger of balling up the bit as the nozzle velocity is increased. The drilling rate under these conditions is a linear function of bit weight to the ball-up point. The tests also indicated that no advantage can be expected if the nozzle velocity is increased unless the bit weight is proportionately increased. Drilling operations would be improved through the use of more weight on bit and volume pumped.

The average rig used today in the prairie provinces can run jet bits to an advantage. Operators using jet bits for the first time should make a study of their rigs with the thought of keeping pressure losses as low as possible in their circulation system. The modification necessary to obtain this will quickly pay out. Jet bit drilling offers fast penetration rates if rig personnel work as a team to capitalize on "drilling breaks" and keep their equipment and mud in top condition.

Conclusions

High fluid velocity jet rock bits drill faster than conventional rock bits in the Leduc field.

Geological sections of the Leduc field are similar in composition to those found elsewhere in the Provinces of Alberta, Saskatchewan, and Manitoba. It is concluded that high fluid velocity jet bits would give comparable beneficial results elsewhere in the prairie provinces.

Recommendations

1. Jet drag bits and combination jet cone and drag bits should be experimented with to determine their suitability to Leduc drilling conditions.
2. Weights in excess of 45,000 pounds to a limit of 60,000 pounds should be experimented with to determine their effect on penetration rate.
3. More experimentation is necessary to evaluate the drilling advantage offered by jet bits when using 7¼ x 14-inch slush pumps which are adequately powered. This is considered to be the smallest pump that can be used with jet bit drilling.

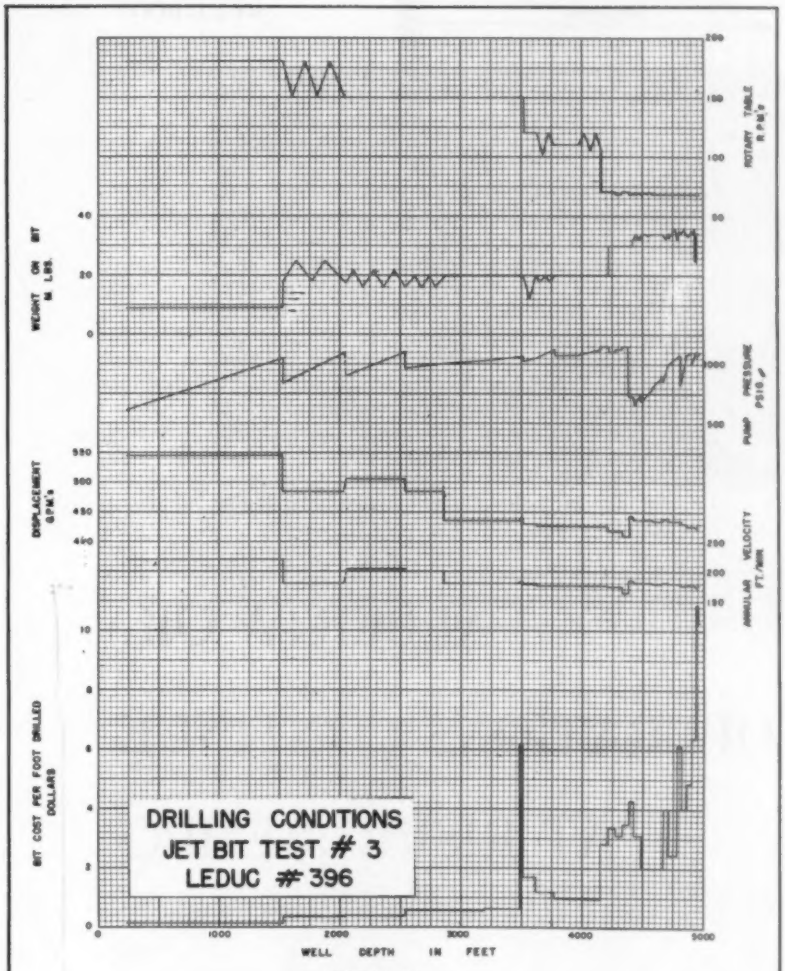


FIGURE 12

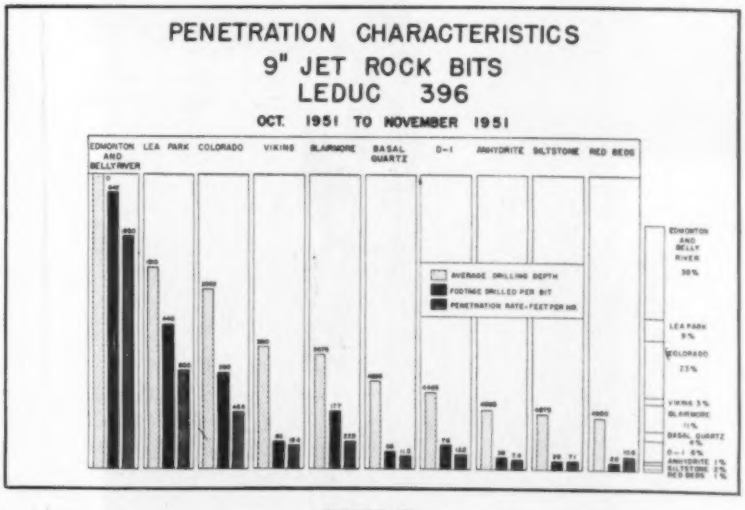
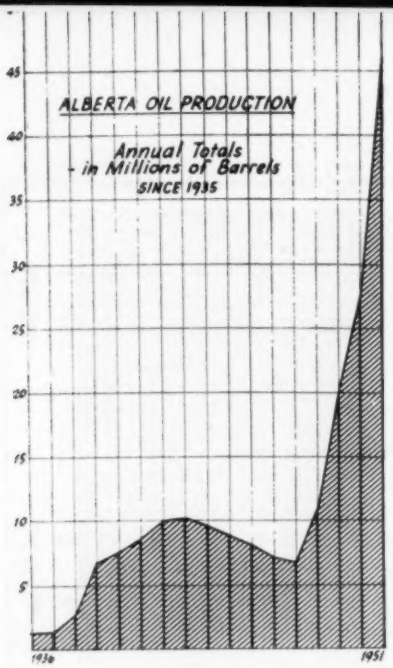


FIGURE 13



BY J. L. IRWIN

ALBERTA OIL OPERATIONS CONTINUE AT RISING TEMPO

CRUDE OIL production in Alberta averaged 122,000 barrels daily in 1951, an increase of 62.5 percent over 1950 when average output was 75,000 b/d.

The increase in output is indicative of the acceleration in tempo of exploration and drilling—indeed of every phase of the oil industry in Alberta. Although neighboring provinces also were active in drilling, Alberta continued to dominate the Canadian oil scene. In 1951 Alberta produced 96.5 percent of the crude output of the entire dominion, compared with 94.5 percent in 1950.

Among the many highlights in this greatest oil year to date in Alberta's history was the spectacular performance of Wizard Lake. Production only started in May, but the field finished the year with the total of 190,595 barrels. There were eight wells in production at the end of the year, and a pipe line to the Edmonton terminal completed and in operation.

Bonnie Glen, six miles south of Wizard Lake, was discovered with some 700 feet of porous zone in the D3 (Devonian) and capable of both natural and distillate oil production. Joseph Lake, with a total at the end of the year recovered from the Viking sand of 727,936 barrels, also constructed a pipe line to the Edmonton terminal which was in operation before the end of the year. Acheson, with a total of 918,158 barrels, just managed to overtake Lloydminster for fourth place among Alberta fields. Lloydminster's total was 900,469 barrels, but this figure represents only the Alberta side of the field. The combined field, Alberta and Saskatchewan, of Lloydminster presented a total of 2,134,319 barrels, a record year, with an increase over 1950 of about 200,000 barrels.

The confirmation of earlier reports that the Trans-Mountain oil pipe line from Edmonton to the Pacific coast would start construction work early in 1952 came before the close of last year. This was particularly welcome news to the Alberta oil industry in that it promised a wider market, which meant increased output and a still further incentive for development programs.

At the close of the year, what were presumed to be the final sessions of the gas export hearings were completed before the Petroleum and Natural Gas Conservation Board in the Calgary court house. An announcement from the Alberta government on this all-important question is looked forward to.

Permission given to export gas will be a boon to development programs of both oil and gas. It will stand as the greatest incentive yet to appear for risk capital to enter Alberta for the purpose of carrying out very much enlarged exploratory programs as well. Expansion of natural gas development will bring new and great

Shot-hole drill in the Loon Lake area of Alberta. Socony-Vacuum Oil Co. photo.

revenues. Because of such expansion, oil wells suffering from adverse gas/oil ratios will have found a solution to that serious problem in the widened market which will become evident for the absorption of this surplus.

Alberta's oil production in 1951 totalled 45,915,384 barrels which had a valuation of $115,809,221, compared with the 1950 total of 27,577,065 barrels valued at $81,498,471. The increase in 1951's production was 18,338,319 barrels or $34,310,750.

Since oil was discovered in Turner Valley in 1914, Alberta has produced 201,847,172 barrels of crude valued at $460,202,771. In the five years since Leduc's discovery and the close of 1951, Alberta has produced 111,521,782 barrels, valued at $308,514,286. The last five years have rolled up a greater production total than have the previous 32 years. Average yearly production in each of these last five years is in the neighborhood of 22 million barrels, with average yearly valuation around $60 million.

Production from Alberta's major oil fields in 1951 as compared with 1950 follows:

Field	Barrels 1951	1950
Redwater	23,177,607	10,746,472
Leduc	13,743,118	10,589,472
Turner Valley	2,952,307	3,771,754
Acheson	918,158	17,411
Lloydminster (Alberta Side)	900,469	809,801
Joseph Lake	727,936	168,855
Excelsior	723,005	272,186
Golden Spike	640,972	292,873
Stettler	606,068	246,198
Wizard Lake	190,595	.....[1]
Taber	182,449	114,916
Duhamel	184,582	.....[2]
Big Valley	155,580	10,710[3]
Conrad	142,497	110,062

[1]production started May, 1951.
[2]production started late 1950.
[3]production started Sept. 1950.

Natural gasoline recoveries in 1951 showed an increase of about 18 percent: Turner Valley led with 457,773 barrels valued at $1,489,944; Leduc, 41,378 barrels valued at $128,393; Jumping Pound, 13,657 valued at $40,030; total natural gasoline recoveries, 512,808 barrels valued at $1,658,367. Leduc led in propane recoveries with 146,825 barrels; Western Propane, 70,324 barrels; with a total for the province in propane recoveries of 217,149 barrels. Butane recoveries at Leduc were 84,527 barrels. The totals of natural gasoline, propane and butane recoveries are not included in the general crude oil total.

Footage drilled in 1951 totalled 5,562,665 feet to compare with 4,330,198 feet in 1950, an increase of 1,232,467 feet. Total recorded footage drilled since 1914 to the end of 1951 is 22,059,253 feet, or approximately 4,177 miles. Alberta's footage drilled in 1951 represents about 1,053 miles, or approximately one quarter of the total covering the entire 37 years of Alberta's oil development.

Dog sleds used by Socony-Vacuum Oil Co. to transfer supplies from plane to exploratory camp in Alberta.

Surveying at Socony-Vacuum's Loon Lake camp.

Operating jet in suction pit on northern drilling project. Imperial Oil Ltd. photo.

An Alberta Christmas Tree of Imperial Oil Ltd.

Producing oil wells in Alberta at the close of 1951 totalled 2,747 to compare with 1,780 by the end of 1950, an increase of 967. Drilling rigs at the end of 1951 totalled 168 to compare with 117 at the close of 1950. Producing oil wells in the major fields at the end of 1951 were:

Field	No. of Producing Wells
Acheson	55
Big Valley	22
Conrad	17
Duhamel	7
Excelsior	32
Golden Spike	9
Joseph Lake	70
Leduc-Woodbend	800
Lloydminster (Alberta Side)	223
Redwater	898
Stettler	45
Taber	21
Turner Valley	330
Wizard Lake	8

Producing gas wells at the end of 1951 totalled 331.

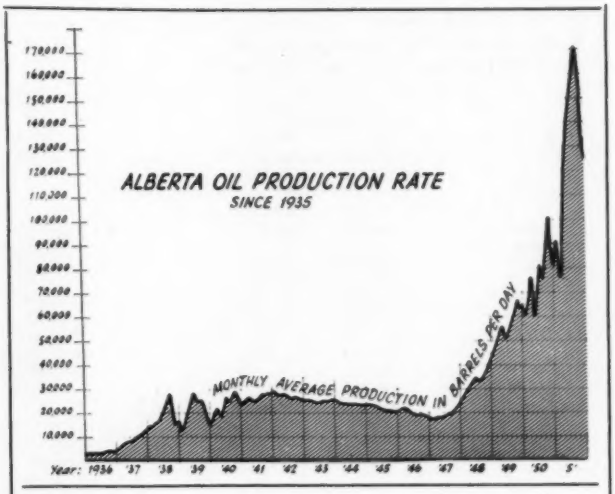
An outstanding discovery of 1951 was Wizard Lake, three miles to the south of the Leduc field's present southern boundary. The appropriately named discovery was made in the earlier part of 1951 by the Texaco-McColl-Frontenac team, and production started in May. Three years prior to this find, exploratory drilling was carried out in the vicinity of the successful wildcat, but without result. Nothing further was attempted until 1951.

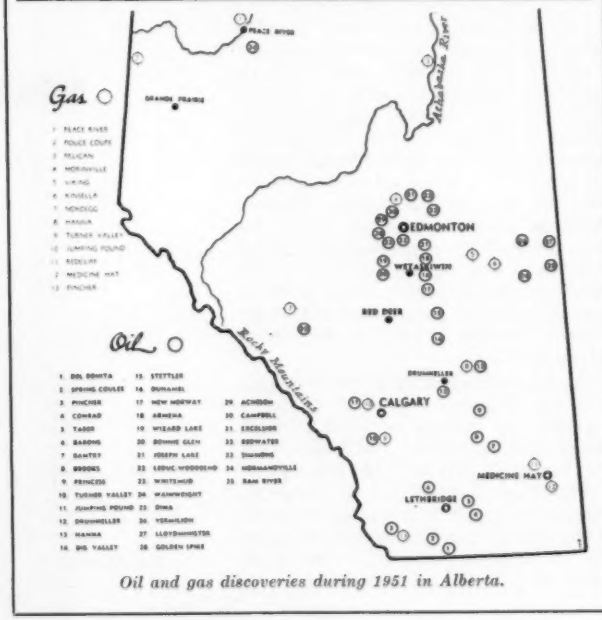
The original producer indicated a four-zone field with gas in the Viking sand, and oil in the Lower Cretaceous and the D2 and D3 of the Devonian. In the November official list of allowable production from wells in the Alberta fields, the figures ran from 42 to 277 barrels daily. Wizard Lake was given the top figure of 277 barrels along with the Golden Spike, situated some four miles to the west of the northern part of the Leduc field (Woodbend). This daily total was allowed for the D3 zone of each field. There were eight producers at Wizard Lake by the end of 1951, and 12 by March, 1952.

One of the most interesting developments among Alberta's many oil fields is that of Joseph Lake in the general Edmonton area. Production first started in April, 1949, from the Viking sand which had produced dry gas in the Viking and Kinsella fields, 80 miles to the east of Edmonton, and was the source for years of fuel gas to Edmonton and the Edmonton area districts.

The team of Superior Oils Ltd. and General Petroleums Ltd. has played a major role in this field and a most successful one. Production from the 70 produc-

Propane torch used to thaw out truck lubricants on a cold morning in Alberta. Socony-Vacuum photo.


ALBERTA OIL PRODUCTION RATE
SINCE 1935
MONTHLY AVERAGE PRODUCTION IN BARRELS PER DAY
Year: 1936 '37 '38 '39 '40 '41 '42 '43 '44 '45 '46 '47 '48 '49 '50 5'



Oil and gas discoveries during 1951 in Alberta.

Control head equipment in the cellar of an Imperial drilling well. Temperature at this site was below zero for 46 consecutive days.

ers in the field at the end of 1951 was in the neighborhood of 720,000 barrels, compared with about 170,000 barrels the previous year. Average monthly deliveries at present from Joseph Lake total 80,000 barrels. Current price is $2.40 per barrel delivered to the Edmonton Pipe Line Co., or $2.65 delivered to Nisku. A pipe line was constructed to the Edmonton terminal last year and was in operation before the year was out.

New Norway in the general Edmonton area is coming to the fore among Alberta's new oil fields. The first discovery in Alberta for 1952 was achieved by Scurry Oils Ltd. with its Scurry-Explorers-New Norway No. 1 well which was drilled in lsd 13 of Sec. 10-44 22 W.

The land on which this well was drilled was purchased at an Alberta Government land auction by an independent and drilled to successful completion by an independent. The well was not a "farm-out" or extension of a known pool, but a straight discovery made by a small independent company. The well-site was the selection of the consulting geological firm of Link and Nauss of Calgary who are managers of Scurry Oils Ltd. Production tests proved the well to be productive in both D2 and D3 of the Devonian. Production is being taken from D3 with a daily allowable of 75 barrels. Open flow from the D3 was rated at 3,500 barrels and the well is placed as the second largest producer in Alberta from this zone, Imperial Golden Spike coming first as the largest.

The outset of the current year of 1952 also was marked by the discovery of the spectacular Bonnie Glen well six miles to the south of Wizard Lake. The find was made by the team of Texaco Exploration Co. and McColl-Frontenac Oil Co. Ltd. which discovered Wizard Lake.

Canada's thickest D3 oil and gas productive reef was found in the wildcat well of this area—688 feet of D3. Of that section, 397 feet yielded a high volume of natural gas plus 60 gravity condensate and about 291 feet gave up 42 gravity crude oil. Flow of the gas with accompanying naphtha was around 10,500,000 cubic feet daily during drill stem tests. A considerably higher potential would have materialized with open flow.

Oil in commercial quantities was indicated on the western shores of Great Slave Lake according to a recent report by Dr. J. D. Bateman, consulting geologist for Ventures Ltd. The site of the development is 600 air miles north of Edmonton. Roughly it is midway between the long established Norman Wells area close to the Arctic Circle and Alberta.

At the western end of Deep Bay, Punch Petroleums of Toronto produced from its wildcat well some interesting cores at a depth of 456 feet. Dr. Bateman stated that outcroppings of the Devonian appear close to the surface in this area. As far back as 1930, Dr. Bateman had been with a diamond drilling crew in the area and was impressed with the oil seepages which came to the surface there. Due to mechanical difficulties, this first well is to be abandoned and another will be drilled in the vicinity.

The well just drilled penetrated the Upper Devonian shales, the Hay River and Simpson formations, and into the top of the Slave Point limestone or mid-Devonian at 365 feet. From that depth to bottom at 456 feet there were showings of oil saturation. Unexpected porosity and permeability were encountered through the thickness of the Slave Point formation. The Presqu'ile formation, which possesses an average thickness exceeding 120 feet in this area, was expected to be topped at 550 feet.

Punch Petroleums has about 1,000,000 acres under reservation in this area. North West Territories Oils Ltd. also has "very substantial" acreage adjoining. Commercial production obtainable on pump is expected.

Lloydminster also had a record year in 1951 with a production total on the Alberta side of the field of 900,469 barrels, and a total for the combined field (Alberta and Saskatchewan) of 2,134,319 barrels.

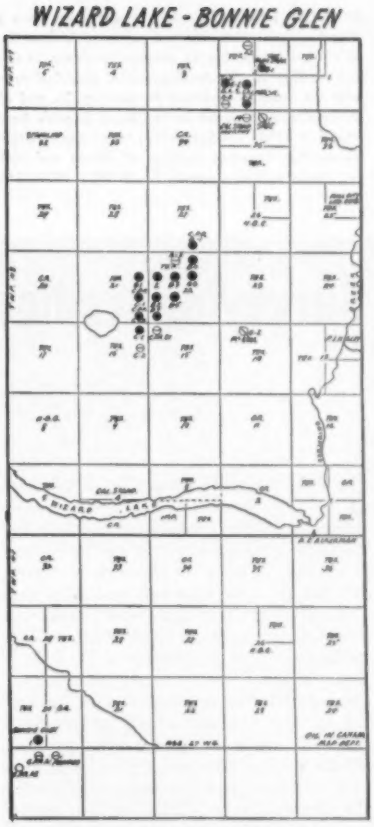
Lloydminster's heavy oil is yearly assuming greater importance. Asphaltic products are finding an expanding market continually in addition to paving uses. Roofing compounds, floor coverings, laminated paper products and molded products represent only a few of the manufactured articles using asphalt.

The Lloydminster field covers a large area stretching eight miles to the north of the town of Lloydminster, 36 miles to the south, 12 miles to the west, and 30 miles to the east. There are many oil pools in this general area. Prominent among them are the Blackfoot pool and the pools of Lloydminster and Lone Rock. Bunker C fuel is of course one of the principal products from this heavy oil. Railways and power plants provide a continually expanding market. Recoveries from the area's many wells are from the Cretaceous sands at depths of around 1,850 feet. A feature in Alberta of Lloydminster's development is that of 10-acre spacing of wells to compare with 40-acre spacing in other parts of the province.

An interesting report from the Petroleum and Natural Gas Conservation Board has been issued in which these two great petroleum areas, the backbone of Alberta oil expansion over the last five years, are reviewed.

Redwater has almost reached a stage of "complete development" with its 898 producing wells. Recoverable reserves of crude are placed at 600,000,000 barrels and life expectancy is 20 years.

The field now is facing problems which an official of the mines and minerals department describes as the natural consequences of continued withdrawal of oil. Sharp drops in bottom hole pressures,



Map of Wizard Lake, Bonnie Glenn area, courtesy Oil in Canada, *Winnipeg.*

principally near the center of the productive area, have become noticeable and some of the wells near the edge of the field report an increase in their water oil ratio.

Solution of the problem is a water-flooding program to bring the drive back to normal. This is being considered by the Board's engineers. The water-flooding program under consideration will start near the center of the field. Increased water pressure would then spread slowly toward the edges of the field, allowing maximum recovery for all producers.

Redwater from its discovery to the turn of the year has piled up a total production of about 40,000,000 barrels. Its first recorded production was 8,772 barrels in October, 1948. In August, 1951 it presented its record monthly total to date of 2,856,051 barrels from the D3 formation, a substantial one-month total.

The cumulative total just given, however, is only about six percent of its recoverable reserves. Over the next 20 years it is hoped that these reserves, totalling 600 million barrels, will be recovered in full by the regulation of water drive at individual wells. The other great Alberta field of Leduc-Woodbend is re-

(Please turn to page 113)

BY HANS LUNDBERG. Mr. Lundberg has been president and manager of Lundberg Explorations, Ltd., Toronto, since 1934. He is a native of Malmo, Sweden, and was a member of the expedition to Spitzbergen in 1915, later serving as assistant professor in mining and surveying at the Royal Institute of Technology and working on the development of electrical prospecting methods in many countries. He was associated with the Swedish American Prospecting Co. and affiliate companies from 1924 to 1931. Mr. Lundberg was awarded a gold medal by the Royal Swedish Academy of Engineering Sciences in 1925 and the John Erickson Medal in 1944. He has written many papers dealing with geophysical exploration, including a recent paper before the Canadian Institute of Mining and Metallurgy describing the method discussed in the accompanying article written especially for WORLD PETROLEUM.

Surveying radioactivity distribution as an indication

SOME two years ago, after Professors Pringle, Roulston and Brownell had developed their scintillation counter for field use, we tried it out in our plane over some known uranium deposits. Interesting results were obtained, and after certain modifications, this instrument was found to be very sensitive with no disturbances from cosmic rays; in fact it was so sensitive that the old idea of searching for oil was again taken up, and for the last year and a half we have carried out airborne surveys over gas and oil fields with this new type of scintillation counter. In close co-operation with the professors in Winnipeg, the instruments have been brought to a state of streamlined perfection which was unthinkable a year ago.

Radioactive studies in connection with soil analysis were carried out by us more than ten years ago in Alberta. By drilling a few feet into the ground, samples were taken and submitted to alpha counts in an ionization chamber. These counts, after certain corrections, were plotted on a map and found to resemble very closely the maps obtained in soil analysis plotting chlorides and methane.

As we all know, the interest in soil analysis was very great, particularly in Texas, but soon the results were looked upon with suspicion. Our air-borne scintillation surveys, however, gave the most interesting and startling results. It was possible to outline from the flown records the oil occurrences over several oil fields, and over new areas indications were obtained which were so interesting that we recommended drilling. In two locations the results are now available. In Texas, we have a well producing some 700 barrels from a fifty-foot reef situated nearly 8,000 feet from the surface. The other results were in Canada, where the drilling of several wells has confirmed the results of airborne scintillation surveys. The results were submitted several weeks before the drilling started and there are now a number of producing wells far from earlier production.

The results are obtained in the form of continuous gamma ray recordings along parallel flight lines, laid out at regular intervals according to predetermined pattern. The direction of the lines is not important and often a grid of lines are flown to cover an area sufficiently. The altitude may vary between 150 and 500 feet above the ground, and the speed of the aircraft may be as fast as 150 to 180 miles per hour. The records are plotted directly along the flight lines of the maps.

Experience has shown that as a rule, radioactive lows are found over the oil fields and that these lows are commonly surrounded by higher than normal radioactivity. However, interpretation of radioactive charts is not always easy, since areas of broken or rugged topography, outcroppings of certain rock types such as shales, and the presence of lakes and rivers obviously affect the variations in the radiation. Very often the entire drainage pattern may be pictured from the radiation map. Lakes, rivers and sometimes swampy lands show marked lows. However, in many cases where water is held stagnant in a swamp, it seems possible to see the pattern caused by the presence of an oil field. Because of the above mentioned factors, great caution and judgment and the best available topographic and geological maps must be used when drawing conclusions from the radiation data.

The results to date certainly have justified the incorporation of the scintillation counter among the tools used for oil exploration, but the question now is how we shall interpret these phenomena and find a logical explanation for the characteristic distribution of radioactive elements in the soils in the vicinity of oil producing wells. In brief, the theory is as follows:

We must assume an upward movement of the waters in the ground. The movement may be very slow, say only one inch per year, but it is upward; otherwise we would not have any oil or gas accumulations in the structural traps. This water is of chloride type and generally free of sulfates. If any sulfates are present, they become reduced to sulfides by the presence of slight amounts of oil or gas in the water. Even the infinitesimal amounts of oil or gas that may be dissolved in the water are sufficient to reduce great amounts of sulfates and make the water sulfate free. This is important since chloride-containing water may dissolve radium, but the sulfate-carrying water would precipitate it (radium sulfate being insoluble in water).

Where does the radium come from? We think it has been dissolved from uranium bearing shales or formations not far from the surface. We cannot assume that the radium has come from greater depth or from horizons near the deep-seated oil or gas deposits, since with the slow movement of the water, radium would lose its energy before reaching very far. For instance, with a movement upward of one inch per year, after rising 800 feet the radium would have lost all but one percent of its energy.

Upon approaching the surface, the waters coming from below will meet descending atmospheric waters. Being rich in oxygen, this water will then oxidize the sulfides to sulfates, and the insoluble radium sulfate will be precipitated. The amount of salt precipitated should be proportionate to the amount of water moving towards the surface from below. If these deep waters, on moving upward, encounter oil or gas accumulations, the direct upward migration is stopped and they are forced to move laterally towards the edges of the oil pool before they are able to continue toward the surface. This outward and renewed upward movement of water is accelerated by the pressure generated in the oil pool and thus a greater concentration of radioactive salts should occur at and near the edges of the oil field, and a deficiency of these over the field itself.

The direction of water movement near and at the surface is ever changing. During rainy seasons the surface becomes saturated, with some of the water moving downward and some flowing off directly into lakes and rivers. During dry seasons

# of oil and gas

the water evaporates from the surface and water from below moves up to take its place, in turn to be taken off into the atmosphere. This continuing process slowly but surely tends to carry the radioactive salts to the surface of the ground where they are precipitated. Even though there may be some removal of these salts during the rainy season, the increase is in general greater than the removal. This would be particularly accentuated in areas where the length of the dry season exceeds that of the rainy season.

The flown records must be processed for linear scale before they can be plotted on the maps. In order to keep the interpretation free from any individual influence, all transcriptions are carried out on small machines with the datum rigidly fixed for all records. Having thus fixed the datum, the graphs may be plotted on maps of a suitable scale and are ready for interpretation. As in the interpretation of the results of other geophysical methods, special attention must be given to topography, geology and to the evaluation of anomalous conditions.

Experience in interpretation based on the study of many records from known fields has been of the greatest value when studying results from unknown areas.

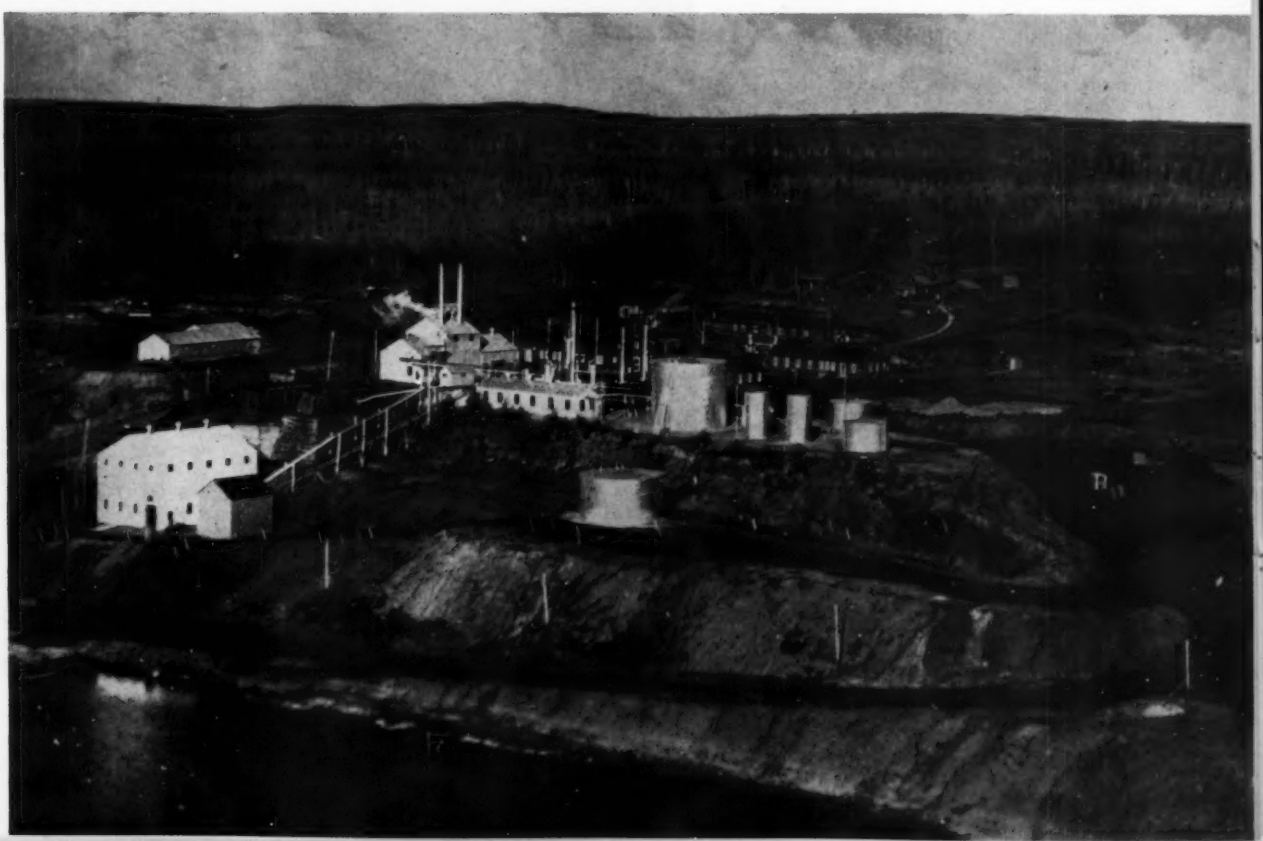
In conclusion it is necessary to say something about the effectiveness of the method as a means of making new oil discoveries. This might be called the "batting average." With reference to drilling for oil and gas in the United States, for 1949 the "batting average" of "wildcat" locations was only three percent, whereas in the holes located by geologists using geological, seismic and gravimetric information, it was 13 percent. Our "batting average" has not been established as yet since the method has only been in use a short time and only a few of the anomalous areas have been drilled. However, if one could draw conclusions from the results obtained over the known fields and add to these the few finds in unknown areas made to date, we have reason to believe that our average will be better than that obtained by the older methods.

Rivers and lakes are often employed as landing fields in winter operations. Imperial Oil Ltd. photo.

Active Studies of Athabaska Oil Sands Undertaken by Seven Oil Companies

Oil-rich sands are scooped from the quarry near the separation plant at Bitumount and loaded into waiting trucks.

The Government of Alberta's bituminous sands separation plant at Bitumount on the Athabaska River, where Swedish scientists will carry out experiments on new separation processes. The plant is located about 55 miles north of Fort McMurray. The quarry from which the sands are taken is at the extreme right.



BY RUTH SHELDON KNOWLES

THE DREAM of a direct oil-finding method becomes paradoxical when we realize that Nature has herself exposed her greatest known source of oil—the fabulous Alberta Athabaska oil sands—and scientists to date have been unable to utilize it. However, recent developments may mean that commercial exploitation of these vast deposits is in sight.

Five independent Canadian companies and two major American oil companies have leased a total of 400,000 acres of land in the Athabaska oil sands area and by June will begin a core-drilling exploratory program to determine the richest portions for exploitation. At the same time, the Swedish Shale Oil Co. is leasing part of the Alberta Government Bitumount pilot plant to experiment with its process of extracting from the oil sands in place by a form of underground combustion.

The Athabaska oil sands, which outcrop along a hundred miles of the Athabaska river and its tributaries and which may blanket some 30,000 square miles of land, are estimated to contain anywhere from 100 to 300 billion barrels of oil. The heavy viscous oil in some places amounts to more than 200 million barrels per square mile. At points the strata is covered by an extremely light overburden and over vast areas is never more than a few hundred feet below the surface.

This behemoth of all oil deposits has fascinated oil seekers and scientists for half a century. Due to the physical nature of the sands, the oil will not drain out nor can it be driven out by normal water or gas pressure methods. It has been a case of "oil, oil everywhere, but not a drop to produce—economically.

Years of experimental work of all sorts by private companies and government agencies finally culminated in December, 1950, in a report by S. M. Blair, at the direction of the Government of Alberta, surveying the possibilities of commercial production. This report estimated that by mining and processing the sands, a distillate product worth $3.50 a barrel at the Great Lakes could be produced and delivered for $3.10 a barrel. This 40 cents a barrel differential did not take into consideration royalty payments, interest on capital or profit. Nor did it consider revenue from valuable by-products such as sulfur and rare minerals.

The Blair report stimulated an Athabaska oil sands conference last fall in Edmonton attended by scientists, oil, mining, and pipe line company and government representatives from all over North America. The present positive action for commercial development is the result of these events.

The fact that the Blair survey was based on a throughput of only 20,000 barrels a day leads the interested companies to believe that if their exploration reveals rich areas where mining costs will be at a minimum, the oil sands could be produced and processed on a much greater volume basis, further reducing costs and making the venture a competitively profitable one.

Another important factor in their thinking is that the wildcatting dollar brings no results eight out of nine times, but where the existence of the oil is known every dollar spent in development and research means a step closer to the goal of ultimate use.

The five companies spearheading this new activity are all Canadian independents: Calvan Consolidated Oil and Gas Corp., Asher Oil Co., Pacific Petroleums Ltd., New Continental Oil of Canada, and Charter Oils. Each of them has been granted a lease of 50,000 acres. Associated with them are an additional five Canadian companies: Sapphire Petroleums. Harman Oils and Minerals, Ltd., Canadian Collieries Ltd., Canadian Merrill Ltd., and Redwater Utilities Holdings and Development, all of which will participate in the joint development.

The group plans to engage core drilling outfits and engineers with previous experience in the area to begin exploration no later than June and to core drill approximately 35 holes on each lease. Each lease of 50,000 acres calls for a $250 fee and a $50,000 deposit. Rentals for the first year are five cents per acre, 10 cents for the second year, and 25 cents for the third. When exploration work is finished, each company holding a lease may lease an amount of exploitation acreage which the government agrees is sufficient to keep a processing plant operating for 20 years. The rental then becomes a dollar an acre and royalty to the government will not exceed ten percent.

The government has deliberately left the royalty question "open end," since at this point, with so many unknown factors in regard to costs, a specific royalty might be such as to prohibit competitive development. The policy of the government has been and is to make all conditions as reasonable and as favorable as possible to stimulate development of this great resource.

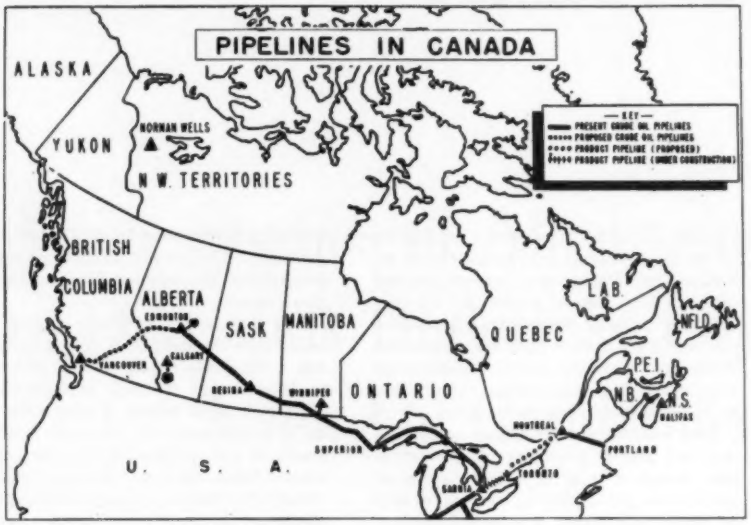
Minister of Mines N. E. Tanner points out that this policy has been adopted "to encourage immediate development to meet the ever-increasing demand for petroleum products, to offset the effect of the uncertainty of supply elsewhere in the world, and to further this continent's security."

In terms of western hemisphere security, the commercial development of the Athabaska oil sands would be of vital strategic importance. The ready availability of such vast amounts of oil would give the western hemisphere the cushion of excess productive capacity which it so desperately needs and does not yet have.

Immediately after the independent companies' plans were announced, Socony-Vacuum Oil Co. applied for a 50,000-acre lease, and Sun Oil Co. and Edward Gilbert, manager of Sun Oil's Calgary land department, applied for two 50,000-acre leases. Shell Oil Co. is sending surface geological parties into the area as soon as weather conditions permit. Other major oil companies are understood to be dusting off their Athabaska oil sands files and it is not unlikely that in the near future the entire potential area will be under lease. This in itself will hasten the day of commercial use.

Although the outlining of the richest area for mining is of first importance, the plan of the Swedish company to experiment with the government plant is of real significance from the processing point of view. The Swedish Shale Oil Co. plans to move into the Bitumount plant by May 1 to try the method which it has successfully used in extracting oil from Swedish oil shale. Although details on the process have not been released, it is understood that the method involves vaporization of oil sands in place by electrical means.

What is happening in Alberta now is proof again that no challenge to the oil industry remains unanswered. However, the ultimate unlocking of this fantastic source of energy will be a far cry from its first commercial use in 1793. Sir Alexander MacKenzie, in exploring that wild country, arrived at McMurray with a badly damaged canoe. He asked the Indians for some of the black "gum" mixture they used on their own canoes. They refused to give him any, but said they would sell him some for a bottle of whiskey. After the reluctant surrender of a precious bottle of Scotch, the wiley Scot proceeded downstream to the sight of gallons of Athabaska "tar" oozing into the stream—free.



Present and proposed crude and product lines in Canada.

Canada is Spending $100 Million To Enlarge Pipe Line System

CANADA has spent well over $200 million to provide a pipe line system for the economical movement of oil and products. Projects totaling another $100 million are under construction or in final engineering stages and the development has just begun. Additional hundreds of millions will be invested in the system during the next decade. Involved will be the enlargement of existing lines, the laying of a "big inch" to the Pacific Coast, the construction of a products line system, and eventually, no doubt, the laying of transcontinental gas lines.

Two years ago Canada had a small 28,000-barrel line from Turner Valley to Calgary; a connection at Sarnia, Ont., with United States pipe lines; and a 68,000-barrel line from Portland, Me., to Montreal. Today the system has increased to some 1,200-odd miles and a period of vigorous further growth is ahead.

Most important current project is the $80 million Trans-Mountain pipe line which will deliver Alberta crude to the Pacific Coast and reduce crude imports from California to British Columbia.

The rapid growth of oil consumption in Ontario in recent years has kept oil companies busy building storage capacity to permit year-around deliveries to consumers from Montreal and Sarnia district refineries by water. The companies now have come to the conclusion that they must develop a pipe line delivery system to supplant or supplement water movement.

Two major lines are projected. One will move products from Montreal west to Toronto and Hamilton, and the other will move products east from Sarnia to London, Hamilton, and Toronto.

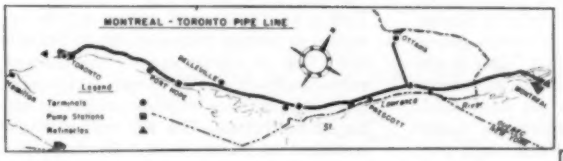
Imperial Oil Ltd. laid the first leg of its products line from Sarnia to London last year. In 1952 it will be extended to Toronto and Hamilton. The Imperial line will have an initial capacity of 39,000 b/d. Length will be 188 miles and pipe diameter 10 and 12 inches.

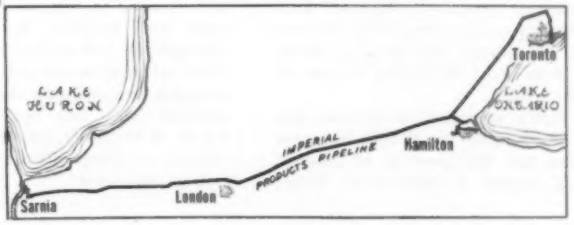
Trans-Northern Pipe Line Co. has been organized by McColl-Frontenac, Shell of Canada, and British-American to build a 400-mile product line system from Montreal west to Toronto and Hamilton, with a branch to Ottawa. The main 10-inch line will follow the north shore of the St. Lawrence and Lake Ontario. The Ottawa branch will be 6 inches. Initial capacity will be 40,000 b/d. This can be increased to 60,000 b/d with the addition of four pump stations and to 75,000 b/d ultimately.

Deliveries will be made to bulk plants of the participating companies at Cornwall, Prescott, Brodsville, Kingston, Belleville, Port Hope, Toronto, and Hamilton. A. N. Horne, who with Burt Hull supervised building of the wartime big-inch

Launching a 115,000-barrel tanker to transport crude from the pipe line terminus on Lake Superior to Ontario refineries. In addition to three Imperial Oil tankers of this class, British American Oil Co. is building a huge lake boat capable of delivering five million barrels of crude yearly.

Work was begun last fall on the Sarnia-Toronto products pipe line. Photo shows work in progress near Wyoming, Ont. All photographs with this article courtesy Imperial Oil Ltd.





Above, map of Montreal-Toronto products pipe line being built by McColl-Frontenac, Shell and British American. Right, map of Imperial's Sarnia-Toronto products line.

Removing ice from the right-of-way of the Interprovincial pipe line which was completed a year ago.

line in the United States and the more recent Trans-Arabian pipe line, is president of Trans-Northern.

River and lake shipping will not be eliminated by the new lines. Heavy oil movement will keep the vessels busy.

The 1,127-mile Interprovincial crude line from Edmonton to Lake Superior was scarcely completed before it became apparent that additional capacity would be necessary. More crude reserves were being developed in the Edmonton region and demand in eastern Canada was skyrocketing. Additional capacity was made available before the lake shipping season started a few days ago and still greater capacity will be provided for in 1953.

In the first full year of operation ending early last December, the Interprovincial line was filled with 1,800,000 barrels of crude, and 14,500,000 barrels of oil was delivered to the Superior, Wis., terminal. First oil reached Superior on Dec. 4, 1950 and by April the twelve 150,000-barrel tanks were full.

During the lake navigation season, about 68,000 b/d of oil was delivered at Superior, of which 4,000 b/d was processed at a local refinery and the remainder shipped by tanker to Ontario plants.

Building program during the past year included the construction of five new pump stations, four in Canada and one on the Minnesota segment. These were completed during the past month. Of equal importance was the construction of twelve 217,000-barrel crude tanks to increase storage capacity to 4,400,000 barrels. The increase in storage and the new stations will permit the line to deliver a little more than 20,000,000 barrels to Superior in 1952.

This year's construction involves the looping of 100 miles of 16-inch line east of Regina and the erection of another group of twelve 217,000-barrel tanks. These are the largest crude tanks thus far built. Crude storage at the opening of the 1953 season will be 7,000,000 barrels. Deliveries at Superior can then be stepped up to 27,500,000 barrels.

The western section of the Interprovincial line consists of 438 miles of 20-inch pipe to Regina, permitting the delivery of crude to the growing group of refineries in Saskatchewan and Manitoba, the Moose Jaw refinery of British-American, Imperial and Cooperative refineries at Regina, and the Anglo-Canadian plant at Brandon. A 70-mile branch from Gretna North to Winnipeg supplies the new Imperial refinery there and the North Star Oil Co. plant at St. Boniface. Input at Edmonton must be about 40,000 b/d greater than required deliveries at Superior in order to supply the refineries mentioned. Requirements will be greater in the future when Imperial's Regina plant is increased to a capacity of 22,500 b/d.

An outstanding feature of the Interprovincial system is the large amount of storage required at Superior to permit the line to operate in winter when lake shipping is shut down. The storage plan is based on a navigation season of 231 days and a period of 134 days during which Superior deliveries must be stored.

The line was buried 42 inches below the surface when it was laid. This is not below frost line, but experience has shown that the oil stream does not drop much below 30°F. At this temperature, pumping capacity is reduced about eight percent and scrapers are kept moving through the line at frequent intervals to clear out possible wax accumulations. The company is sponsoring research into cold-weather pipe line operations through which it is anticipated that new information on pumpability of oil in winter will be developed.

In addition to the main line construction, the field gathering facilities are being improved and new laterals are being built to recently discovered western fields which are being actively developed.

An 8-inch line from the promising new Wizard Lake field and the adjacent Joseph Lake is being laid to Edmonton for delivery of crude to the McColl-Frontenac refinery there and to connect with Interprovincial. The 42-mile line will have an initial capacity of 12,000 b/d and an ultimate of 30,000 barrels with additional pumping equipment.

Edmonton Pipe Line Co. is building a 6-inch line from the Joseph Lake field some 20 miles Northwest of Edmonton. This will provide an outlet for about 3,000 barrels of production in that area.

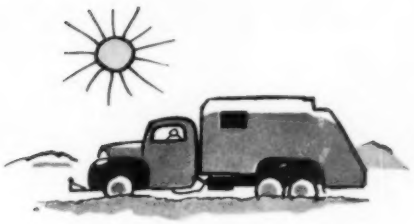
Canadian Gulf Oil Co. will start construction in the immediate future of a 9-mile 6-inch crude oil gathering line from the Fenn-Caprona field to the Big Valley field. Later in the year, Canadian Gulf Pipe Line Co. will build an extension of this 6-inch line north to the Stettler field and also construct a 12-inch crude oil pipe line from Stettler to Edmonton via the New Norway area.

Upon completion, which is anticipated in the Fall, this line will provide economical pipe line transportation facilities for crude oil from fields along its route to Edmonton. This will permit pipe line deliveries of oil to refineries located in the area and will also provide connections at Edmonton with Interprovincial Pipe Line Co. and the projected Transmountain Oil Pipe Line Co. Detailed plans and formal application for construction permits are expected to be filed with the appropriate provincial authorities in the near future.

Construction of the Canadian Gulf Pipe Line will be under the local supervision of B. M. Moroney, Gulf pipe line engineer, who will maintain an office at Edmonton.

The Portland-Montreal line of the Portland Pipe Line Corp. and the Montreal Pipe Line Co., Ltd. is another example of the old adage that no pipe line was ever built large enough. Originally, a 12-inch line was laid to permit year-round delivery of oil to Montreal plants and to reduce the long haul up the Atlantic coast and down the St. Lawrence. In 1950 a second 18-inch line was laid, increasing capacity from 68,500 b/d to 135,000 b/d. This year a new pump station will be installed to permit deliveries up to 141,000 b/d. This is almost exactly the current refinery capacity at Montreal, which suggests that another building project is not far in the future. The $20 million Portland line is jointly owned by Imperial, Shell, McColl-Frontenac, and British-American.

Although Canada is engaged in a 50 percent expansion of its investment in oil and product lines, it appears obvious that pipe line construction in the Dominion will continue active for many years to come.



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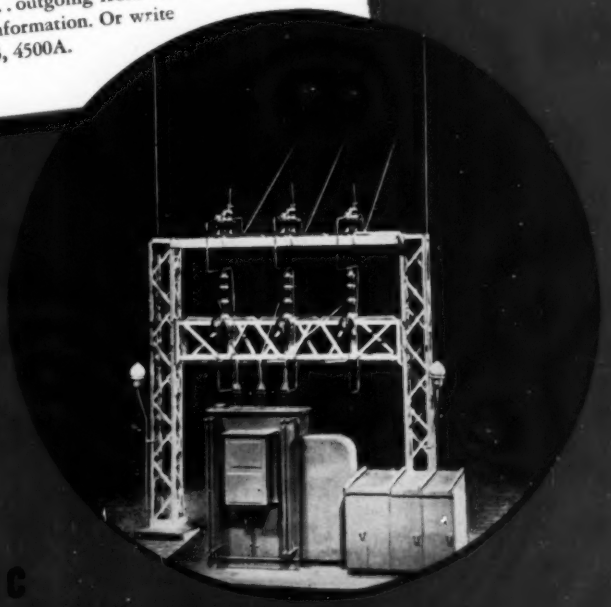

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Alberta Oil Operations

(Continued from page 103)

ported performing normally and, according to engineers, offers no immediate problems. The gas/oil and water/oil ratios governing bottom hole pressures tend to fluctuate, varying very much at individual wells. No problem, however, has arisen to date.

Leduc was discovered in February, 1947. With a lead of 18 months over Redwater in productive performance, the cumulative total of Leduc-Woodbend is roughly the same as that of Redwater, which means that these two principal fields of the province over a period of five years have so far produced together a cumulative total of about 80 million barrels.

Leduc-Woodbend produces from three zones—Lower Cretaceous, D2 and D3 (Devonian)—to compare with Redwater's one-zone field of the D3. Like Redwater, Leduc also has a life expectancy of 20 years. Recoverable reserves are placed at 225,000,000 barrels.

A difference between these two fields exists, however, in that Redwater is considered nearly "drilled out," where as Leduc-Woodbend is continuing its drilling program with the same activity as in former years, and is still growing in area, especially in the southern end of the field.

Producing wells in the field are Lower Cretaceous, 19; D2, 363; and D3, 418, making a total of 800 for all types. The Lower Cretaceous has a cumulative production total of about 600,000 barrels to date, but since the close of 1950, no new wells have been completed in that formation. The D3 production of Leduc-Woodbend has been heavier than the D2. The D2 totals, however, have been increasing each year since the field was discovered, and the differences in production totals between the two zones have been steadily reducing each year.

After a period of approximately half a century, in which the great Athabaska tar sand area in the McMurray district has been subjected to minor development at different times and seasons, the whole question of economic recovery of the product assumed an entirely different viewpoint following a report to the government by Sidney M. Blair early in 1951. The report led to a government-sponsored symposium on tar sands development which was held in September of last year at Edmonton and at the Athabaska government plant, and progress made was demonstrated to visiting oil men from all parts of the world.

The government policy then announced included provisions that a company undertaking exploratory work should acquire a licence for a fee of $25 and a deposit of $1,000. The company could then operate freely, the government being advised of progress made. Permits were granted for areas up to 50,000 acres for a $250 fee and a $50,000 deposit. Rentals for the first year are five cents an acre, 10 cents for the second year and 25 cents for the third. In addition to these payments, work must be carried out on a government-approved program.

On completion of the exploratory work, the company is entitled to lease acreage sufficient in the government's opinion to maintain a mill in operation for a period of 20 years. The rental becomes $1 an acre. For the first term of 20 years, royalty is arranged up to 10 percent.

On March 15, 1952, an announcement came from the Minister of Mines and Minerals, the Hon. N. E. Tanner, to the effect that five independent Canadian oil companies had plans for development of the Alberta oil sands to start soon.

The companies have acquired reservations covering some 250,000 acres west of the Athabaska River. Added to this, the minister stated that a Swedish oil company was making arrangements to lease the province's experimental plant at Bitumount. A new oil extraction process, not yet proven, is to be tested.

The Canadian companies, each with leases of 50,000 acres, are Calvan Consolidated Oil and Gas Corp., Asher Oil Co., Pacific Petroleums Ltd., New Continental Oil of Canada, and Charter Oils. The foreign firm is the Swedish Shale Oil Co., represented in Alberta by Hans Lundberg and Dr. Gosta Salomonsson. This firm will endeavor to recover oil from the sands by means of a heating system in use at the present time in Sweden.

The area covered by the leases of the five companies is immediately west of the Athabaska River in the vicinity of the Mildred-Ruth Lake section of the general oil sands area. This particular section came into prominence in recent years as a result of Dr. Hume's report issued by the federal government.

Ford tractor equipped with bombardier tracks used in geophysical work at Buffalo Head Hills, Socony-Vacuum photo.

The marketing of Alberta's natural gas has now become one of the greatest of Canada's economic questions. There is opposition to the export of Alberta's surplus gas in certain quarters and strong support in others. By keeping the gas at home, some people maintain, industries will come to the province. Proponents of gas exports assert that the more gas that is exported out of the province, the greater the home reserves will become—as consumption increases so do the reserves because markets stimulate further drilling. If there is no market for the gas discoveries of new areas, risk capital will not come in. The greater the reserves become at home, the greater will be the expansion of the gathering lines throughout the province. By this expansion the lines will approach farming communities in remote districts and the question of servicing them with gas will have become possible. By refusal of export this cannot happen.

Finally, in answer to the oft-repeated statement that export must be denied so that by-products of gas may be extracted in the home area and not in areas beyond the province, it is again said that no gas may enter a pipe line for transmission to some distant point without the by- products having been first removed.

In all branches of Alberta's ever-expanding oil industry, there lies a definite promise of increased development on a major scale, not only for the new year of 1952, but also for the years to follow. It is to be hoped that a similar promise will come to the general industry for expansion in natural gas development as well. With this to be added to what has already been achieved, a major oil and gas industry of vast proportions will have been launched for the general economic betterment of Alberta and Canada.

BY J. C. MAYNE

SOME ASPECTS OF FINANCING WESTERN CANADA'S PETROLEUM AND NATURAL GAS INDUSTRY

J. C. Mayne, supervisor of Alberta branches for The Royal Bank of Canada, has been closely identified with Canadian oil development for a number of years. As manager of one of the bank's principal Toronto branches for 15 years, he was in close contact with leading oil companies with headquarters in Eastern Canada. In 1950 he was transferred to Calgary as manager of the Calgary branch in order that he might be close to the remarkable development taking place in the Alberta oil fields at that time. Shortly afterward, he was appointed supervisor of the bank's 57 branches in Alberta with headquarters in Calgary. Under Mr. Mayne's direction, a new and considerably enlarged oil department, staffed by experts in the oil and gas business, is being set up by The Royal Bank to provide even wider service to those engaged in the business and to facilitate their operations in Canada.

TO DATE more than 200 million barrels of crude oil and natural gasoline have been produced from Western Canada's oil fields. The year 1951 accounted for more than 46 million barrels of this production, nearly one-fifth of Canada's entire output, for an average rate of about 129,000 barrels daily. The tremendous growth of the nation's petroleum industry, particularly during the past five years, is continuing unabated with discoveries of oil and gas being made at the highest rate in Canada's history.

Before the Leduc discovery in 1947, the only major Canadian oil field was at Turner Valley, where "wet gas" was first discovered in 1914 and crude oil in 1936. The field reached its peak production figure of around 30,000 barrels daily in 1942. However, prior to Leduc in 1947, Alberta was producing only 19,000 barrels of crude oil per day, about one-third of the needs of the Prairie Provinces, which were dependent upon imports from the United States for the remaining two-thirds. The Prairies were faced with substantial increases in products costs due to the necessity of bringing oil in by rail transport from distant points. The nation as a whole was far from self-sufficiency in petroleum, a resource vital to the functioning of the economy.

During the 1930's and 40's, several small oil fields and pools were found on the plains of Alberta, but payoffs to the explorers from those strikes were slow and small. Many oil companies became discouraged and retired from Western Canada. However, numerous natural gas discoveries had been made and it was just previous to Leduc that a number of major oil companies were making preliminary plans for the use of gas to make synthetic gasoline for consumption in Western Canada.

With the discovery of oil at Leduc by Imperial Oil Limited, after a multi-year exploratory program involving the expenditure of around 23 million dollars and including over 120 wildcat dry holes, hope came to Alberta for another major oil field and the synthetic gasoline plan was abandoned. The discovery well, about 20 miles southwest of Edmonton, poured out oil at the rate of 1,000 barrels per day from a mile-deep Devonian coral reef. The result was a major strike with engineers' estimates of recoverable oil reserves being around 250,000,000 barrels (that being more than twice as much as Turner Valley has so far produced). Shortly folowing was the prolific Redwater discovery with recoverable reserves now estimated at around half a billion barrels of oil. Numerous smaller oil strikes have been made, with Wizard Lake shaping up as the one most likely to develop into a major field. However, Leduc was the turning point in Canada's oil industry as it did prove that major fields are present in the Devonian structure on the Alberta plains, making that formation one of the hottest and most sought after objectives at the present time.

(Please turn to page 116)

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Aspects of Financing Western Canada's Petroleum

(Continued from page 114)

Leduc brought a rash of activity in Alberta with operators establishing their bases in the cities of Calgary and Edmonton. Old Turner Valley firms became active again and new Canadian companies were being formed as the oil play started a rapid expansion. A stream of American oil companies entered Alberta as did oil companies from other continents. Currently, some 200 Canadian, United States and other foreign companies are actively carrying out an exploration and development program covering around 175 million acres of oil and gas rights in the four western provinces. Scores of other firms are also associated with the industry in the form of supply companies, drilling contractors, geophysical contractors and service companies of various types. It will readily be seen that from the employment standpoint alone, the oil industry has brought tremendous benefits to the Prairie Provinces.

The Alberta Government's treasury has benefited substantially from these developments through its ownership of about 90 percent of the petroleum and natural gas rights in the province. During the five-year period since the Leduc discovery, the Provincial Government has collected some 125 million dollars from the sale of Crown leases, royalties, rentals and oil industry fees. The Government's current plan of leasing proven and semi-proven oil land brings high cash bonuses, plus normal fees and rentals and a gross royalty averaging about 12½ percent on all production for the life of the oil wells drilled on the land. Saskatchewan, Manitoba and British Columbia are also garnering benefits from oil exploration in terms of fees and rentals paid for Crown-owned rights, but not to the extent of Alberta, as they are not yet able to reap the percentage from production returns and sale of proven oil land. Major oil discoveries are the answer to obtain those results.

Another benefit brought about by this important oil development is the substantial decrease in Canada's dependence on oil importation and thus a reduced need for United States dollars. Western Canada is now self-sufficient insofar as its petroleum requirements are concerned, and the prairie consumers have benefited directly from the lowering of gasoline prices and other petroleum products. The price of crude oil is based on the competitive price at the most distant market served by that production, less the cost of transportation to that outlet. With the completion of the pipeline connection from Edmonton to the Great Lakes, Alberta oil is now reaching the Ontario market, resulting in a reduction in the wellhead price of the product to allow for the increased transportation costs. This reduction is also reflected to a certain degree in the prices of the refined products. It has been estimated that the prairie consumers would have spent some $50 million more in 1951 if Alberta crude oil had not been available.

During the past five-year period the majority of the oil and gas discoveries in Western Canada have been concentrated in the province of Alberta. However, the increased exploration activity in the other provinces resulted in new oil strikes in Saskatchewan, Manitoba and British Columbia last year.

Today the oil industry is spending an average of three million dollars per week on drilling, geological and geophysical phases of exploration and development. Around $200 million was spent on this work last year. More millions of dollars are being poured into lease and reservation fees and into bonuses to Government and private mineral right owners. Actual revenue in 1951 from crude oil and natural gasoline sales was slightly more than one-half as much as the annual spending on exploration and development operations.

In the five years since Leduc started the current oil boom, more than one billion dollars of capital investment has been made in Canada's oil industry. This includes over half a billion dollars invested in the acquisition of land, in exploration and development. The balance has been for pipe lines, tankers and other transportation facilities for oil and gas, for expansion of refining facilities in Western Canada and Ontario and for plants and other facilities to provide equipment, pipe, tools and other supplies to the oil industry in Canada.

During the past three years some $250 million has been spent to transport Alberta's oil and to refine and distribute it, making possible an average daily market for 1952 of around 160,000 barrels daily. Additional huge sums of money will have to be spent during the current and coming years to increase fa-

(Please turn to page 118)

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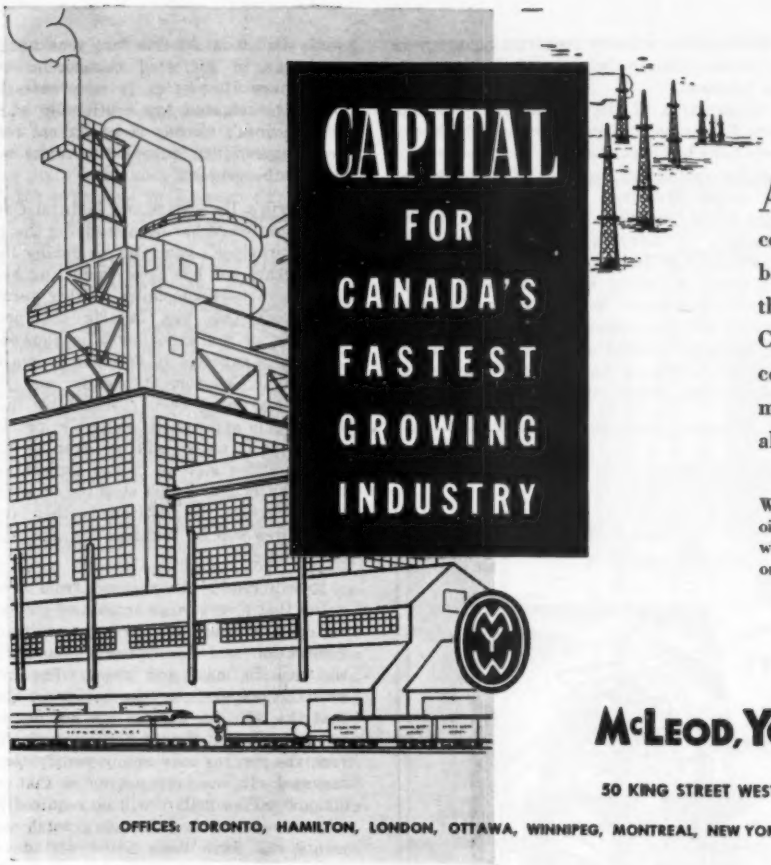

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Aspects of Financing Western Canada's Petroleum

(Continued from page 116)

cilities and attain new markets for the crude oil so that higher production rates will be obtained.

Last year for the first time Alberta's oil reached markets in Ontario and the central United States through the Inter-provincial Pipe Line. That eastward market expansion has meant a pipe line expenditure of over $90 million, linking central Alberta with the Great Lakes and with prairie refining centers; construction of tanker fleets to transport crude from lakehead to Sarnia and Toronto; and a $100 million refinery construction program in prairie cities, in Ontario and at the American lakehead.

Construction of the $83 million pipe line from Edmonton to Vancouver over the Rocky Mountains has been started. That line, scheduled for completion in 1954, will probably at the outset transport about 40,000 barrels daily, with provision for a substantial increase in its carrying capacity. The Inter-provincial Pipe Line to the east at that time will likely be taking around 200,000 barrels daily to refineries in Saskatchewan, Manitoba, Ontario and the American lakehead areas.

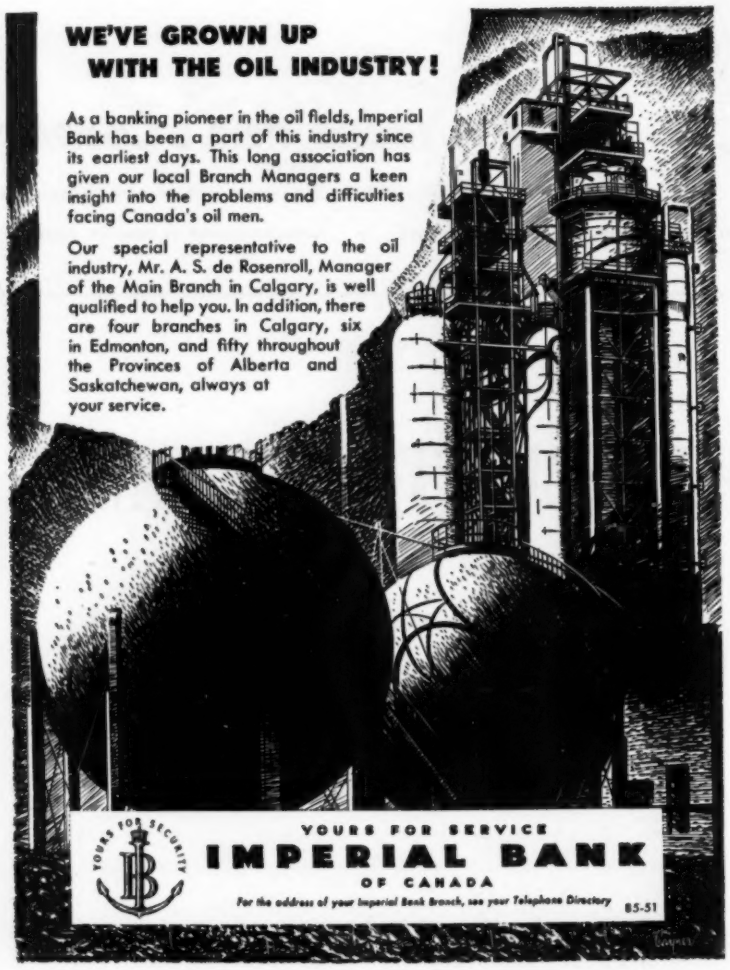
Tied in with Alberta's oil industry are the steadily increasing natural gas reserves of the province. About one in every five wildcat wells drilled in Alberta last year found natural gas in indicated commercial volume. These new discoveries, in most cases still to be fully evaluated, are continually adding to the province's already large current reserves. In all probability, future discoveries will far exceed the current.

Alberta's Petroleum and Natural Gas Conservation Board has been studying the growth of the province's gas reserves during the past three years and has been conducting hearings for the various companies seeking permission to export this gas outside the province. Whether or not export will be allowed from Alberta is expected to be made known by the Provincial Government shortly, and the decision may have been revealed by the time this article appears. If export is proclaimed, a further incentive will be given to oil companies, and a step-up in gas exploration and development may dwarf even the current large scale program. In addition, further large expenditures will be required for gas pipe line construction.

It will readily be realized from the foregoing that a very large amount of risk or venture capital is required to carry out this huge exploration and development program as is the case in most new areas. The investor must be prepared to take a chance, knowing that the odds for success are not necessarily in his favor, but that if his judgement is correct, the returns may amply justify the risks assumed. It has been estimated that an additional billion dollars will be required before oil reserves to meet Canada's total requirements will have been found and developed along with adequate refining and marketing facilities.

As it would probably be many years before the petroleum industry could finance such a large expenditure out of income, it is obvious that a substantial amount will have to be obtained from outside sources. A large portion of the costs of the exploratory work must be carried by the larger companies out of accumulated surpluses from previous operations. In addition, a great deal of this venture capital has come and is still coming from public financing through the sale of company stocks and bonds. In other words, the investors, both large and small, representing Canadians from all parts of Canada and in all walks of life, are in some measure contributing to the development of Canada's oil industry.

The Canadian chartered banks are also assisting in the development phases of the oil industry. Loans, commonly referred to as "oil production loans" are granted against the anticipated future proceeds of production from wells to enable the borrower to have these funds available for immediate use. In this manner the development program of a company can be greatly accelerated, provided oil reserves are sufficient to protect advances adequately. Bank financing is also used by many of the companies associated with, but not necessarily actually engaged in, the exploration of oil and gas areas. Drilling and geophysical contractors may require loans secured by an assignment of accounts receivable to provide funds during that period of awaiting returns. Supply houses may obtain advances to purchase oilwell casing, tubing, drill pipe, etc., against which security may be taken by way of an hypothecation of ware-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house receipts covering the goods purchased. In these instances, the bank is usually providing the working capital against future income to enable the company to maintain its current operations at the desired level.

Following are a few of the yardsticks used in the petroleum industry which bring into focus the expansion in Western Canada's oil and gas exploration and development field operations:

At the time of Leduc's discovery, only 20 drilling rigs were operating. Now 237 are at work. Also during that expansion period, geophysical operations increased from 15 crews to a current 157. In early 1947, around 20 million acres were under exploration commitment by oil companies. Now around 175 million acres are being actively explored. Exploration has extended from the United States border in the south, through the province of Alberta into the Northwest Territories, west into northeast and central north British Columbia, and east into Saskatchewan and southwest Manitoba. Well completions are being made at the rate of better than four per day, while in "pre-Leduc" days the rate was one every three days.

In order to maintain the present high level of activity, sufficient new discoveries must be made to warrant the large capital outlays and the risks involved, new markets must be found for the resulting increased production, and transportation and refining facilities must be extended to meet the enlarged requirements. This continued expansion entails large capital investments which will be forthcoming only because the operators and private investors have confidence in the future of Western Canada's oil and gas industry.

Catalyst for Canada

American Cyanamid Co. recently completed a catalyst manufacturing plant at Michigan City, Ind., which was located especially to serve Canadian refineries as well as those in the northern part of the United States. In Canada the company's products are distributed by North American Cyanamid Ltd.

North American Cyanamid is a significant factor in the Canadian chemical economy with two multi-million dollar plants at Niagara Falls, Ont., one of which has been in production since 1907. These plants are important producers of fertilizers and heavy chemicals, such as ammonium nitrates, sulfuric acid, ammonia, cyanides, and dicyandiamide. Products from these plants move into the United States and world markets as well as serving domestic Canadian requirements. Cyanamid is a large contributor to the chemical industry of Canada and is growing with it. The use of Cyanamid "Aerocat" fluid cracking catalysts is likewise growing with the Canadian demand for finished petroleum products.

Forms Canadian Company

Geophysical Service International Corp., 706 Ninth Ave. West, Calgary, Alberta, Canada, has been formed to take over all operations of Geophysical Service Inc., in the Dominion. It will be under the resident direction of Charles M. Moore, Jr., vice president and manager. Supervisory personnel includes T. A. Halbrook, E. A. Keisler, R. H. Rainey, and J. L. Stevens. W. E. Dickson is equipment supervisor and Jack L. Clark continues as office manager.

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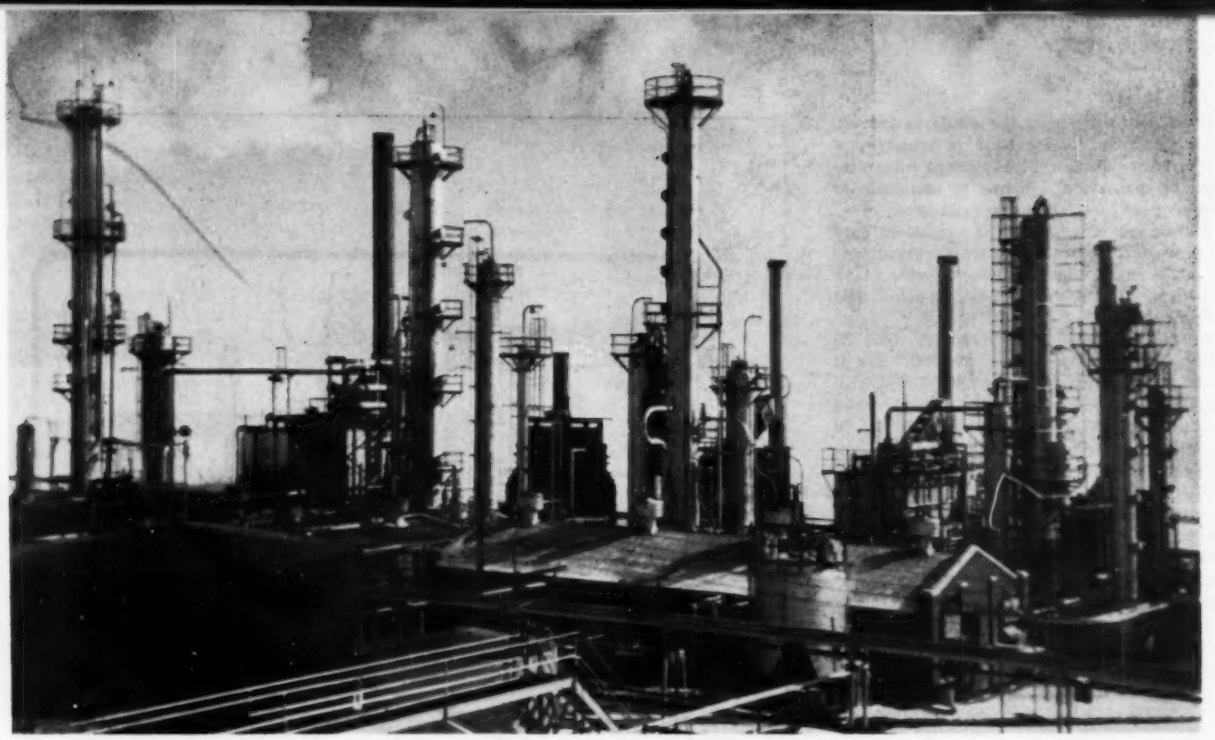


Saskatchewan Federated Cooperative refinery at Regina which doubled its capacity recently.

Saskatchewan Oil Search Spurred By Medium Oil Discovery

THE SEARCH for oil in Saskatchewan has developed at a rate which may never before have been equalled in the petroleum industry of North America in regard to area covered and amount of money spent in so short a time.

In the fiscal year 1940-41 the first oil was produced—331 barrels—but there was no further production until 1944-5. In 1951, production was up to 1,239,000 barrels. Development is still forging ahead at a great pace, and oil men are looking forward to the completion of a $30 million program during 1952.

The present major oil play started in the Spring of 1949. By the end of 1951, preliminary geophysical work was fairly well completed. Then came the costly and more detailed seismic surveys, core-hole drilling, and actual exploratory drilling.

In the Spring of 1950, heavy crude was discovered in the Kerrobert area near Heart's Hill, and a year later heavy crude was found at Eatonia, 65 miles south of Heart's Hill. It was followed by a show of light oil and a natural gas find at Brock, a promising show of light and medium oil at Dahinda, a heavy crude and natural gas find at Coleville, and a natural gas find at Dodsland. At the close of 1951 a major heavy crude field was being developed at Coleville.

The first showing of light oil in the province occurred in a well near Tompkins. The Hulett sandy limestone topped at 3,631 feet did not result in a commercial field and was soon overshadowed by a commercial find of medium oil near Fosterton in January of this year. The new year was only three days old when the wildcat was brought in, with an initial flow of 24° gravity oil from a depth of about 3,100 feet. Two stepout wells have been drilled since the discovery. The first showed about 100 b/d through a ¼ inch choke, while the second was a 300-barrel well, about the same as the discovery. None of the wells has been completed for a comprehensive test.

Although concentrated in southwestern Saskatchewan, the oil boom is spread over a total area of approximately 70 million acres. The expenditure of $18 million in 1951 was more than double the amount of money spent in 1950. There was unquestionably more cash spent in those two years than has ever been spent in Saskatchewan oil history.

In 1951, 401 core holes and wells were drilled in Saskatchewan, as compared with only 148 in 1950. The total footage drilled was 576,381 feet, over 100 miles of hole, more than double the footage of 256,283 drilled in 1950.

There are two major oil areas in Saskatchewan. One covers an extensive district around Lloydminster, located on the Saskatchewan-Alberta boundary in northwestern Saskatchewan. It includes such fields as Lloydminster, Lone Rock, Maidstone and Dina-Marsden. The other area is located farther south at Coleville.

The Lloydminster area fields produce 13 gravity black oil found in the Sparky sands just below the natural gas producing Colony sands. It contains a small amount of gasoline.

In 1950, the only production of oil in Saskatchewan came from the Lloydminster fields. It then recorded a production of over a million barrels and resulted in the erection of an asphalt plant at Lloydminster.

In the Coleville field, production stems from the Mississippian Banff sands. The zone is about 60 to 70 feet thick, and includes sand with shale interbeds topped at a depth of approximately 2,650 feet. The oil is found in fine grained sand, which has a shale and limestone capping.

The year 1951 witnessed the beginning of the third and most important phase of natural gas exploration in Saskatchewan. The first phase consisted of isolated discoveries at Lloydminster, Kamsack, and Unity. The second phase was entered in 1949, when the extensive oil and natural gas exploration program was commenced. Massive natural gas exploration and development programs have been undertaken recently as the result of agreements between private companies and the provincial government. Discoveries in 1951 have already resulted in the beginning of three separate programs to prove up natural gas fields.

First important discovery of natural gas in 1951 occurred in August at the Royalite - Alberean - Coleville No. 1 well. Subsequently other discoveries were made which indicate gas reserves larger than those presently serving the town of Lloydminster. The Coleville discovery was followed by a discovery well at Brock, some 30 miles southeast of Coleville. Since that time, the Husky-Phillips team which made the discovery has undertaken a program to prove up the field. The first step-out well there proved a major success.

The natural gas in the Coleville field is produced from the Upper Cretaceous Viking sands at about 2,250 feet. This sand zone is approximately 12 to 20 feet thick. It is very fine grained "pepper and salt" type quartz. Open flow figures vary between two and ten MMcf.

The Brock field also produces from the Viking sands at 2,300 feet. Open flow runs between 10 and 40 MMcf per day.

In December of 1951 a natural gas find was made at Dodsland, northeast of earlier discoveries at Coleville and Brock. Natural gas was found in commercial quantities in the Viking sands at a depth of between 2,197 and 2,218 feet. The find formed a triangle with the other discoveries at Brock and Coleville. It is thought that these discoveries may lead to the development of a Saskatchewan version of the Viking-Kinsella field in Alberta, where there were a number of producing fields concentrated in one area.

At Elrose, Viking sand gas was found at 2,065 feet. The discovery well tested seven million cubic feet daily.

Further north in the Lloydminster fields, some of the natural gas producing Colony sands to the east have definite oil possibilities. The depth of these sands is 1,600 feet plus. Natural gas production for 1951 in the Lloydminster area amounted to 398,730 mcf. Production is gained from the Colony sands in the Lower Cretaceous.

The total natural gas production in Saskatchewan for 1951 was 860,082 mcf. Broken down into the various fields, 398,730 mcf were produced at Lloydminster, 10,490 mcf at Lone Rock, 437,700 mcf at Unity, and 13,162 mcf at Kamsack.

The search for oil and natural gas fields in the province also resulted in the discovery of potash and salt at Unity. A million-dollar salt plant there produces about 125 tons of salt daily from a bed 435 feet thick and 3,500 feet underground.

Saskatchewan's oil production has been processed in ten refineries, two of which are located on the Alberta side of the Alberta-Saskatchewan boundary.

The Co-op refinery in Regina was the scene of the greatest development in 1951. Its capacity was increased from three to six thousand barrels a day. The Imperial Oil refinery in Regina can process up to 20,000 barrels a day. Hiway Refineries operates a 2,800-barrel refinery in Saskatoon. The British American Oil refinery in Moose Jaw is increasing its capacity from 6,000 to 15,000 b/d. The Trans-Empire refinery there is now increasing its capacity from 1,400 to 2,000 b/d. In Kamsack, the Northern Petroleum Corp. refinery has a capacity of 800 b/d and the Hiway refinery in Rosetown has a daily capacity of 300 barrels. The remaining Saskatchewan refinery at Prince Albert can run 1,000 b/d. The two Alberta refineries at Lloydminster process most of the crude from Saskatchewan's Lloydminster - Lone Rock fields. The Husky Oil refinery there has a capacity of 5,000 b/d, and the Excelsior refinery 2,500 b/d.

Of great interest in regard to the oil and natural gas development program during the latter part of 1951 were the new oil regulations. They were put into effect on June 8, 1951 by the provincial government. The new regulations govern permits and leases of Crown petroleum rights, held by the Province of Saskatchewan, for exploration and production of petroleum and natural gas.

These regulations themselves are another indication of the rapid growth of Saskatchewan's oil industry. Only a few years ago, the province had no regulations governing oil exploration and development. The former regulations were put into effect in 1943, expanded in 1945, and amended from time to time. In actual practice they were found to have certain deficiencies—among them, the term allowed for exploration was not sufficiently long nor was the required work done set out with desirable clarity.

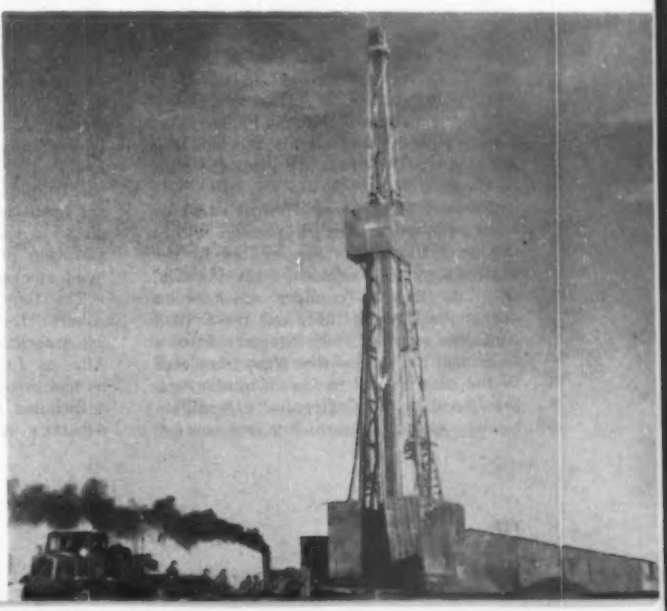
The new regulations are specifically designed to encourage exploration. They provide for a long term and low acreage rental during the exploratory period. They provide that a generous area may be taken on lease for the protection of the permittee around a discovery well. It must be recognized that regulations applying in an area such as Saskatchewan must be somewhat different from regulations which might apply in proven or semi-proven areas.

The oil companies operating in Saskatchewan now include some of the largest in the world, as well as small American and Canadian, and some purely local companies. Seismograph work this year will continue in at least the same tempo as last year, and in all probability will increase. In any event, there will be extensive drilling in the extreme southern portion of the province. New wells are being spudded every week, and taking all factors into consideration, it is hoped 1952 will witness more outstanding Saskatchewan discoveries.

(Note: The above article was prepared especially for WORLD PETROLEUM by the Bureau of Publications, Government of Saskatchewan —Editor.)

Map showing location of oil and gas fields in southern Saskatchewan. Flame is symbol for gas discovery, derrick for oil. Photographs and map are reproduced through the courtesy of Saskatchewan Bureau of Publications.

Socony-Western Prairie Fosterton No. 1, Saskatchewan's first commercial discovery of medium gravity oil.



Aerial view of the Canadian side of the St. Clair River at Sarnia, Ont., which is the scene of much building activity. Existing installations of Imperial Oil Ltd., Polymer Corp., and Dow Chemical are being enlarged and Sun Oil Co. is preparing to erect an entirely new refinery.

Canadian Refiners Increase Capacity at Rapid Rate

CRUDE OIL charging capacity of Canadian refineries has increased nearly 40,000 barrels daily in the past 12 months. Four completely new refineries have gone on stream in the race to keep up with skyrocketing Canadian demand for petroleum products.

Unfortunately for the peace of mind of Canadian refiners, the rate of building has not been sufficient to keep pace with demand. In 1952, domestic oil requirements in Canada rose 52,800 barrels daily, a great deal more than the new capacity added. Currently it is calculated that domestic refining capacity in Canada is about 100,000 b/d below the needs of the Dominion. This means that the industry has a busy period ahead despite the fact that it has doubled its capacity since the close of the war.

Three of the four new refineries which have gone on stream in Canada within the past 12 months are located in the prairie provinces. They are the Imperial Oil Ltd. plant at Winnipeg which began operations in June 1951, and the British American and McColl-Frontenac refineries at Edmonton. Major new plant completed in the central part of the Dominion was the Canadian Oil Companies' $18 million refinery near Sarnia which is just now being activated. A complete report on this latter plant is given elsewhere in this issue.

Three major developments have marked the refinery operations of British American Oil Co. during this year. A new B-A refinery went on stream at Edmonton, Alta., a large-scale expansion and modernization program got under way at the B-A Moose Jaw, Sask. refinery, and plans were announced for the construction of a $1,500,000 grease plant at the Clarkson, Ont. refinery. There were a number of other major developments outside the refining field including the official opening of the company's new head offices in the British American Oil Building, Toronto; participation in the newly formed Platte and Trans-Northern Pipe Line companies; construction of a 125,000-barrel lake tanker; formation of a petrochemical company on a partnership basis; accelerated exploration program; and further development of crude oil sources.

The Hon. E. C. Manning, Premier of Alberta, formally opened the latest British American Oil refinery near Edmonton, Alta. on June 27, 1951—13 months after he had turned the first sod.

Included in the modern equipment is Alberta's first catalytic cracking unit, which was built for the company by Canadian Kellogg. The Edmonton refinery's "cat cracker" is the second to be erected by B-A, the first being at Montreal East, Que., the company's largest refinery (current throughput is more than 40,000 bbls. daily).

Serving the northern part of Alberta and parts of Saskatchewan and B. C., the Edmonton refinery draws its crude from the nearby oil fields. Main source of supply is Redwater.

Present capacity allows for the processing of 5,200 bbls. of crude daily. The process units consist of a combination of crude topping, delayed coking, catalytic and thermal cracking, and gas recovery sections, with treating facilities for white products. Extensive facilities are installed to serve these manufacturing units. The delayed coking process was especially selected for inclusion in the over-all arrangement since it enables the plant to produce a minimum of bunker fuels for which there is a limited demand in Alberta due to abundant supplies of coal and natural gas.

The topping section of the plant removes quantities of light straight-run naphtha, solvents, kerosine and diesel fuel which, after chemical treatment, are

blended into finished products. The remaining crude is then passed through the cracking sections of the plant where it is cracked into gas, gasoline, cycle oils and coke.

High voltage electricity is delivered by the local power company to the refinery. Steam is manufactured by boilers capable of producing 120,000 pounds of steam per hour. Installed with the boilers is a complete feed-water treating system and other necessary facilities.

Water for the refinery is drawn from the North Saskatchewan River. Two intake lines run into the river for a distance of 300 feet and are anchored to the river bed by means of concrete. Water flows through these intake lines to the deepwell pump-house on shore, from which pumps move the water to the refinery—a distance of 6,000 feet and 250 feet above water level.

Comparatively little crude tankage is required since the B-A refinery is supplied with crude via pipe lines. Tankage capacity of 460,000 bbls. is used in processing and for storing finished products. One feature of the tankage installation is the vapor conservation system. This is a system of pipe work connecting tanks containing volatile products with a central gasholder. This system conserves valuable hydrocarbon gases which would otherwise be lost by "breathing" caused by temperature changes, etc.

In addition to manufacturing units, the 160-acre plant has an administration building, where all engineering, accounting and administrative activities are centered; a laboratory, where quality control testing takes place; a combination stores and shops building; and a changehouse for refinery personnel, including locker room, wash room and lunch room. First aid facilities are provided. An "airfoam" and water hydrant system protects the entire refinery in case of fire.

Nearly twenty-seven miles of steel piping were used on construction, plus several miles of cast iron and transite piping. Approximately 8,775 tons of concrete were poured. About 2,100 tons of steel were used for the tanks.

The current expansion program at the B-A Moose Jaw, Sask. refinery is designed to boost its crude oil capacity from 6,000 to 15,000 bbls. daily.

Scheduled for completion in June 1952, the program includes the installation of Saskatchewan's first catalytic cracking unit, a kerosine treating unit, coking plant, thermal cracking unit, catalytic polymerization equipment and additional tankage.

Also slated for extension are water pumping and cooling and field piping and pumping facilities. Additions are being made to the steam generating capacity, electrical distribution system, and sewage. Shops, stores and a new control building will also be built.

Existing combination topping, vacuum and thermal cracking units will emerge, after expansion, as the new crude topping and vacuum unit.

An existing building will be converted into a combined laboratory, changehouse and locker room.

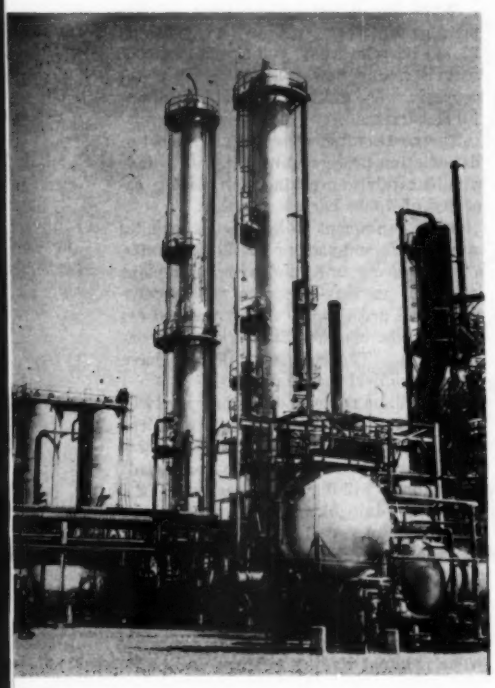
Cooling water supply has been enlarged by the construction of a dam across a nearby creek. The reservoir created has a capacity of 175 acre-feet.

A 22-mile B-A owned pipe line supplies Moose Jaw refinery with Alberta crude tapped from the Interprovincial Pipe Line just north of Moose Jaw.

British American Oil announced plans in November, 1951 for the construction of a new $1,500,000 grease plant at its refinery at Clarkson, Ont. The plant is to have a capacity of 15,000,000 pounds yearly and will reduce to a minimum the quantity of grease at present being imported by the company from the U. S.

Construction of the plant, which will be British American's first major grease manufacturing installation, is expected to be completed early in 1953. It will be equipped to manufacture a full range of automobile, industrial and aviation greases.

The plant's packaging equipment will all be on a weight-controlled basis, thus ensuring packaged products of full measure. The building housing the plant is to be of concrete block, 250 feet long by 100 feet wide.



British American Oil Company's newest refinery is at Edmonton. New type desalting sphere is shown in foreground. At right rear is ortho-flow catalytic converter. Combination and crude towers are in the center background.

Heading the list of construction projects completed within the past year by McColl-Frontenac Oil Co. Ltd. is a new refinery at Edmonton, Alta., built for the company by Foster Wheeler, Ltd. Designed to process 5,500 barrels per day of Western Canadian crude oils, this refinery was built as a combination unit. The process equipment includes an atmospheric distillation unit, a 2,240 bpsd delayed coking unit, a 2,640 bpsd fluid catalytic cracking unit, and catalytic polymerization and treating units. Although the facilities provided are directed primarily towards a high motor gasoline yield, diesel fuel and domestic heating oils may be produced to meet requirements.

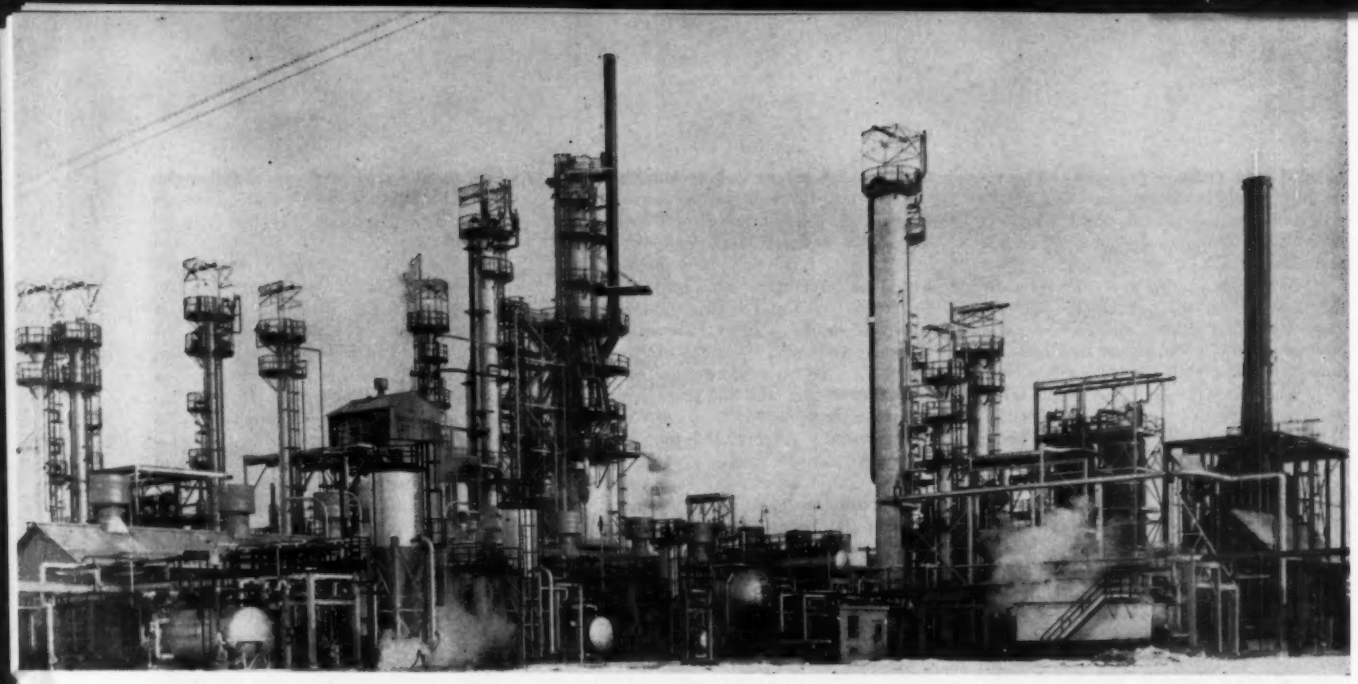
At McColl-Frontenac's Montreal works, some of the existing process equipment has been expanded during the past year. These include increased capacity of the pressure flashing unit from 18,000 to 24,000 bpsd, enlargement of the visbreaking unit from 10,600 to 12,000 bpsd, expansion of the naphtha reforming unit from 3,400 to 4,000 bpsd, and of the catalytic polymerization unit from 1,000 to 1,500 bpsd polymer production. The steam generating capacity was increased with the installation of a 75,000 pound per hour boiler operating at 250 psig. Storage facilities are being increased with the erection of two 150,000-barrel storage tanks.

Although McColl-Frontenac has been blending and distributing lubricating oils and greases in Canada for many years, the company has not been a lube oil manufacturer. Plans are now under way for the installation at the Montreal works of a lubricating oil manufacturing plant to produce solvent refined motor oil stocks. The manufacturing facilities will include a vacuum distillation unit, a Furfurol refining unit, an MEK solvent dewaxing unit, and a contact clay filtering unit. It is expected that the construction will be commenced this year, and the plant will be ready for operation about December 1953.

The crude distillation unit at Montreal is being enlarged to provide increased capacity and supply a segregated reduced crude charge for the lube oil plant. The fractionating tower will be 12 feet in diameter, 130 feet high, with a design throughput capacity of 24,000 barrels per day. A portion of the existing crude stilling facilities will be retired when the new equipment commences operation.

The thermal cracking unit at Montreal will be expanded this year from 4,000 to 5,000 barrels per day fresh feed by the rehabilitation of the furnace capacity. This equipment will be used to thermally crack fluid catalytic cycle gas oil.

Construction crews have begun converting a sprawling Indian reservation at



McColl Frontenac Oil Company's newest refinery erected at Edmonton with a design capacity of 5,500 b/d of prairie crude.

Sarnia, Ont., into the site of a highly efficient refinery planned by Sun Oil Co. to supply its growing Canadian market.

Engineering construction contractor for the project, which is scheduled for completion in the summer of 1953, is the Catalytic Construction Co., operating through its Canadian subsidiary, Catalytic Construction of Canada, Ltd.

The new refinery will have a capacity of between 10,000 to 15,000 barrels a day of crude oil. The main processing plant will consist of combination topping, vacuum distillation, Houdriflow catalytic cracking and catalytic reforming units.

Principal products will be high quality gasoline, kerosine, domestic heating oil and residuals. The Sun refinery will also supply unsaturated feed stocks to the neighboring Polymer Corp. for the manufacture of synthetic rubber. Unused butanes will be returned to Sun for blending.

According to present plans, crude to be run initially at the Sarnia refinery will be transported from the southern part of the U. S. in the Mid-Valley System and the existing pipe line which now serves for the transfer of the butane-butylene fraction from Sun's Toledo refinery to the Polymer Corp. plant.

The site on which Catalytic Construction forces are now at work has been described as ideal for a refinery location. On high ground along the St. Clair River within the city limits of Sarnia between Highway No. 40 and the Chesapeake and Ohio Railroad line, the site provides ready access to shipping by water, highway and railroad.

Moreover, the river itself offers excellent cold water for process cooling. The plant will be powered principally by electricity furnished by Ontario Hydro-Electric. Offsite facilities planned include a river water cooling supply system, an adequate waste water treating plant, and facilities for loading products for water, rail and motor transportation.

Catalytic Construction Co., which is doing the engineering design and construction on the Sun project, has set up an office in Sarnia and has taken on additional construction and maintenance work in Canada.

Although this refinery at Sarnia will mark its first manufacturing operation in Canada, Sun Oil Co. for many years has had marketing, exploratory and drilling operations in that country.

Sun Oil Co. since 1923, through its wholly-owned subsidiary, Sun Oil Co. Ltd., has marketed motor gasoline to Sunoco retail outlets in the Canadian provinces of Quebec and Ontario and other petroleum products directly to Canadian customers.

In 1949 Sun established a Canadian production division with headquarters at Calgary, Alta. Since that time the company has intensified oil exploratory efforts in that part of Canada.

Imperial Oil Ltd. completed one major project during the past year and is currently engaged in four others. The completed project was the entirely new Winnipeg refinery which went on stream last June. Currently, the Sarnia refinery is being modernized and enlarged and a 10,000 b/d cat cracker and an 8,500 b/d vacuum unit are being erected at Edmonton. Future work starting soon or already under way involves the investment of more than $20 million in the Ioco refinery near Vancouver, B. C., and modernization of the Regina plant.

The work at Sarnia will increase crude capacity from its present level of 55,500 b/d to 71,000 barrels. Involved in the program is the erection of a 46,500 b/d atmospheric and vacuum distillation unit and a 23,250 b/d fluid catalytic cracking unit. The Sarnia modernization and enlargement will cost about $14 million. Completion is scheduled for the end of this year.

A $13,500,000 construction program has been undertaken at Imperial's Ioco refinery. Preparation of the site is now under way and erection of the new equipment will start in the Fall. It is hoped the work will be completed in the late Fall of 1953. The enlarged refinery will process crude oil pipelined from Alberta.

When the expansion program is completed, the refinery will have a capacity of 22,500 barrels a day, compared to 12,000 barrels a day now. In 1915, when the refinery was built, daily capacity was 1,000 barrels.

The new equipment will replace most of the existing process units. It will include a fluid catalytic cracking unit with a capacity of 7,600 barrels per day.

Other equipment to be erected includes atmospheric and vacuum distillation units, a gas recovery unit, and a treating plant in which various products will receive their final processing. All of the process units will be operated from a central control room. The refinery will also have a new technical building.

A $7 million modernization program will be carried out at Imperial's Regina refinery. Construction is expected to be completed early in 1954. When completed, the refinery will have a capacity of 22,500 barrels daily, compared to 20,000 barrels now.

New units will include an 8,100-barrel vacuum pipe still, a 7,500-barrel fluid catalytic cracking unit, a light ends plant and treating facilities, new steam generating equipment and additional storage tanks.

The original Regina refinery was built

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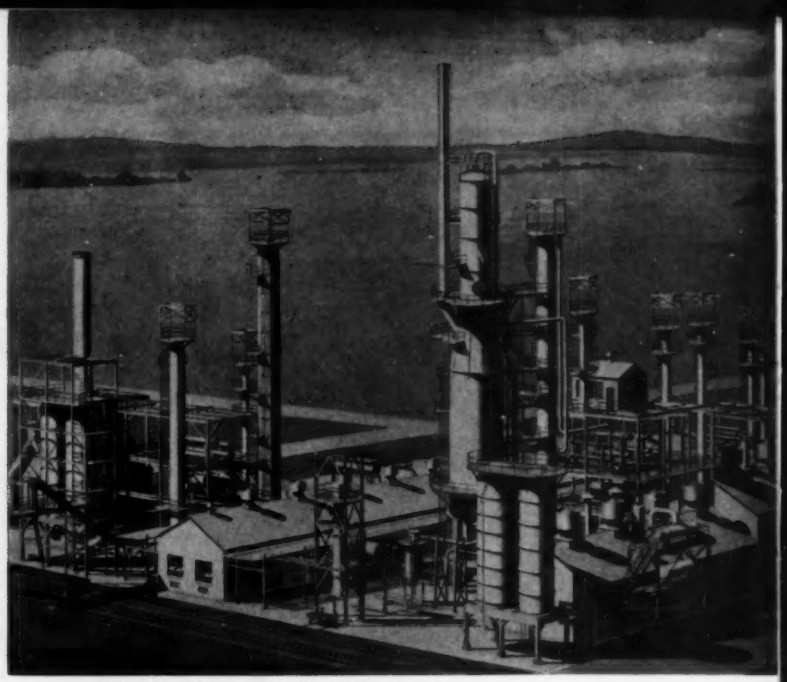
General view of Imperial Oil's new 10,800-barrel Winnipeg refinery showing crude distillation unit at right and fluid cat cracker at left.



The Edmonton plant of McColl-Frontenac is a highly integrated combination unit in which crude distillation, delayed coking and fluid cat cracking are combined.

at a cost of $2,500,000 in 1916. Capacity was 1,500 b/d. Wyoming crude was received by tank car.

The new Imperial refinery at Winnipeg which went on stream last June has a rated capacity of 10,800 b/d of crude and a fluid cat cracking unit with a capacity of 3,100 b/d. Design of the plant product-wise was based on local consumption requirements of the Manitoba sales area. It was decided to provide for the future addition of naphtha reforming and catalytic polymerization when desired.

The site is approximately eight miles from the center of Winnipeg on the Red River, and has access to both the Canadian National and Canadian Pacific Railways. The processing equipment is in one plot area and flow through the refinery has been arranged to minimize interconnecting piping. All field piping is laid on sleepers at grade.

The refinery fire protection system is based on air foam trucks and, in order that these trucks can have access to the tank lot at all seasons of the year, certain tank fire walls have been converted into elevated roadways. Even with a heavy snow-fall, it is expected that wind will blow the bulk of snow off these roadways.

Redwater crude is charged to the unit atmospheric and vacuum crude pipestill through a Petreco Desalting Unit. The desalting unit itself is somewhat novel, since the desalting drum is a sphere 15 feet in diameter rather than the three vertical drums which Petreco has used in previous installations of this capacity.

In the Petreco Electrosphere Desalting process, the crude is emulsified with a relatively small percentage volume of fresh water and this emulsion is passed through a suitable electric field in which it is caused to break and the water to fall out, carrying the dissolved salts with it. The desalted crude then flows to the process unit. The flow through the electrosphere is continuous and as nearly automatic as possible in order to reduce operating attention to a minimum and to ensure stable conditions in the entire processing unit. If the crude, because of its acid condition, requires adjusting, caustic may be added to neutralize the acidity. Any vapor flashing off in the desalting unit is admitted to the crude fractionator at the flash zone.

Both atmospheric and vacuum furnaces are of the Petrochem Isoflow Radiant-Convection design and have heat to oil duties of 30.6 and 12.2 million btu per hour, respectively.

Universal Oil Products Co. was selected to prepare the process design for the fluid catalytic cracking and gas recovery unit at the Winnipeg refinery. The reactor is fitted with an external catalyst stripper and contains one main grid and two distribution grids. This combined vessel is self supporting and results in substantial capital savings over the conventional side by side reactor-regenerator supported in a steel structure.

The gas compressors, absorber, stabilizer and depropanizer of the gas concentration system have been designed so that they may be used in a future expansion of the gas concentration unit to handle both catalytic and reformer gas at higher pressures. This is required for propylene recovery in the preparation of a polymerization plant feed stock.

The process design and specifications for the product treating unit were prepared by the engineering department of Imperial Oil. This unit consists of four separate systems as follows: a natural naphtha system, a cracked naphtha system, a cracked gas oil system, and a natural gas oil system.

The three process units are served by a common control room fitted with a color graphic panel.

The Winnipeg refinery supplies a market which has extreme seasonal fluctuations in product demand. Tankage was installed taking these fluctuations for each product into account, and amounts to slightly over one million barrels.

Product shipping is directly from refinery storage for finished products to either tank cars or tank wagons. Transfer and loading pumps are located at five stations in the tank lot to minimize piping. These stations consist of drained concrete pads without any shelter.

The refinery separator is a circular unit of Dorr design located below grade and equipped with continuous top skimming for oil removal and bottom skimming for sludge removal.

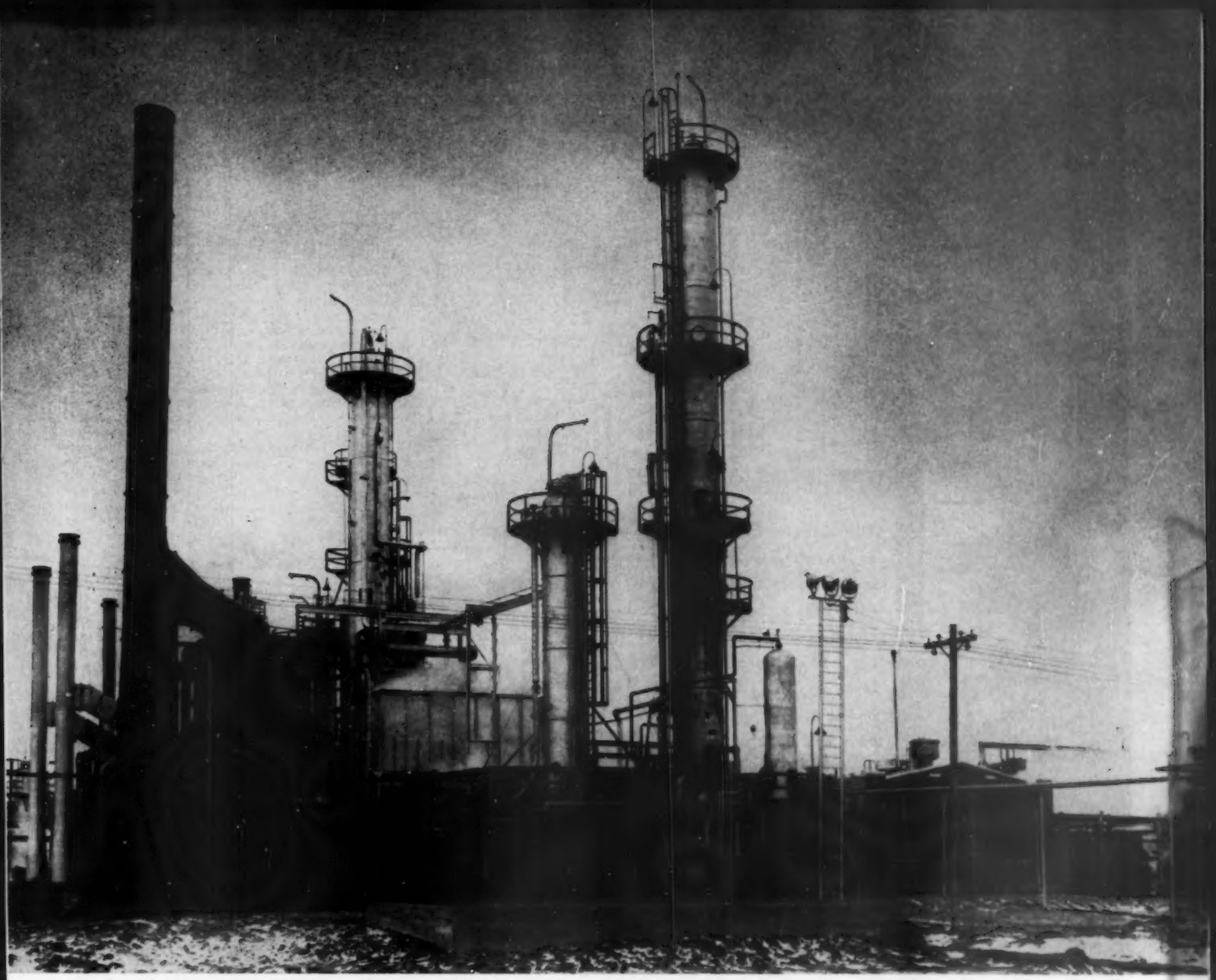
Discharge from the refinery separator is limited to an innocuous stream containing no substances detrimental to aquatic life. The efficiency of this type of separator also reduces the oil content of the effluent water to trace quantities.

The utility plant includes two 50,000 lb/hr boilers which are built outside, with the firing aisles located inside the utility building. This building also houses pumps and air compressors, placing all utilities for the refinery except river water pumping under the control of the utility plant personnel.

The water cooling tower is a two-cell unit of Fluor design, and is located adjacent to the utility plant. Treated water is used as cooling tower make-up.

Husky Oil and Refining Co. is continuing the expansion of its asphalt refining facilities this year. A new furnace and vacuum unit is being erected for asphalt refining, a blow still for oxi-

(Please turn to page 128)



Progress Report . . . .

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Gas and Oil Products, Ltd.
Husky Oil and Refining, Ltd.
Imperial Oil Company, Ltd.
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Royalite Oil Company, *Limited*

Head Office: Calgary, Alberta, Canada

EXPLORATION-DRILLING-PRODUCTION-PIPELINES-NATURAL GAS

Canadian Refiners Increase Capacity At Rapid Rate

(Continued from page 126)

dizing asphalt is to be installed, and the Petreco treating plant is to be enlarged. About 100,000 barrels of new storage capacity is to be added.

During the past year Husky enlarged its steam plant, installed an additional desalter, enlarged asphalt producing equipment, built new loading docks and added to refinery storage.

Also during the past year Excelsior Refineries Ltd. installed two Petreco desalting-dehydrating units, a vacuum furnace and a vacuum tower with auxiliary equipment. These installations increased the company's refining ability from 1,200 barrels per stream day to 2,500 barrels per stream day.

During the year 1951, Anglo-Canadian Oils Ltd. expanded topping facilities from 2,100 barrels per day to 3,000 barrels per day. This involved the addition of heat exchangers, additional pumping equipment and the expanding of induced-draft cooling equipment. Anglo-Canadian also increased its Dubbs cracking unit from 900 barrels per day to 1,200 with the addition of a secondary reaction chamber cut in series with the present chamber. In order to effect the recovery of front end gases, a complete polymerization unit was installed, the end use being to recover excess gases and to produce poly gasoline for quality improvement.

Anglo-Canadian completed during 1951 an addition 35,000 barrels of gasoline storage which was needed to handle increased production.

Although the industry as a whole has projected an active building program for the remainder of the year and for 1953, it does not seem likely that the building will be adequate to permit the Dominion to reduce its imports of refined products. The economy of the Dominion is expanding at such a rapid pace that building to keep abreast is difficult to accomplish. Outlook is that Canada will be building new refineries and expanding current facilities for many years to come.

Western Canada's Natural Gas

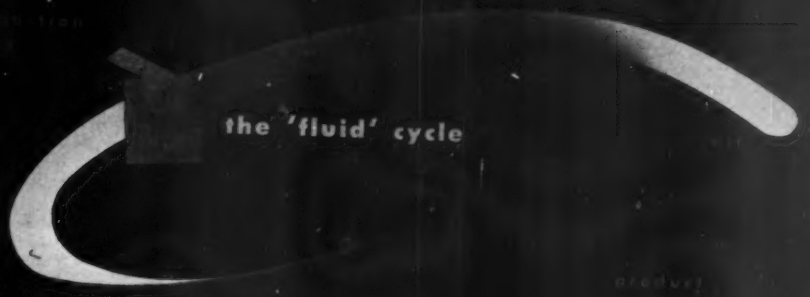
(Continued from page 81)

Canadian Delhi and Trans-Canada Pipe Lines proposed an all-Canadian route from Alberta to Montreal, with branches to serve cities along the route and industrial parts of Ontario and possibly Quebec. They have been conducting a very energetic program of exploration for gas with considerable success, and would in addition purchase from other owners of gas reserves. As outlined earlier in this paper, they have sponsored the most thorough appraisal of Alberta gas resources that has yet been attempted.

Meanwhile, export of a limited amount of gas over a limited time was authorized in 1951. The fields to the southeast of the Foremost field which had been explored by McColl-Frontenac and Union were sold to Montana Power Co. and the gas was needed for smelting copper at Great Falls. A request from Washington to Ottawa set forth the urgent need of fuel for smelting copper as a defense requirement. Ottawa passed the request on to Edmonton and the Hon. E. C. Manning, Premier of Alberta, placed the request before the Alberta Legislature, which body passed an act permitting limited export for the purpose mentioned. A pipeline was laid, but some time elapsed before the Federal Power Commission authorized imports to the United States. Coal interests opposed the import of gas and claimed it would affect the coal industry adversely. Authorization to import gas came through early in Feb. 1952 and gas started into the line very promptly afterward.

Several projects are under way for use of gas within Alberta. A nickel refinery at Fort Saskatchewan will bring nickel concentrates from Sherritt Gordon's new mine for reduction. Rayon is to be made using British Columbia cellulose and chemicals derived from gas, using principally propane and butanes extracted from gas. About the only industry now interested in methane is Consolidated Mining and Smelting's ammonia plant in Calgary, and it now produces about ten times Canada's demand for ammonia and fertilizers. A new plant at Kimberley, B. C. being constructed this year will use ammonia

catalytic reforming



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from Calgary, and it is quite possible that the present 250 tons per day capacity of the Calgary ammonia plant may soon require an increase of the order of 60 percent.

In general, freight rates affect the price of products delivered to world markets to such an extent that the cheapness of gas as fuel or as a material entering a finished product is of less importance. Several years ago at a hearing instigated by Turner Valley operators who desired an increase in the price of gas, objection was taken by the ammonia plant which felt that a higher price for gas would affect their operations adversely. On disclosing their annual budget, the Natural Gas Utilities Board remarked that cost of gas was only a small fraction of the total budget, being exceeded by labor costs and other items unconnected with the price of gas to such an extent as to make a relatively small increase in cost of gas immaterial.

Notwithstanding local considerations of freight, labor costs, etc., increased uses for gas within Alberta are expected, and Canadian Delhi went very much out of its way to look for increasing uses of gas within the province, only to come up with very much the same forecast of future demand as had been reached through other routes of analysis by the Conservation Board.

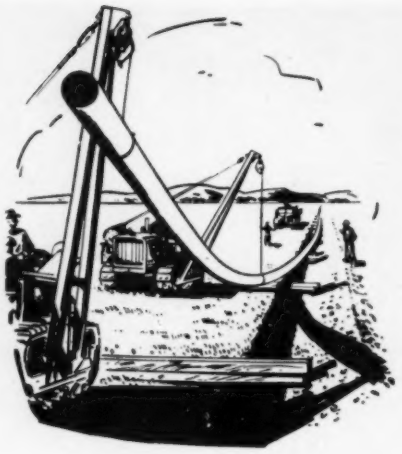
On April 2, the 1952 report of the Petroleum and Natural Gas Conservation Board and its recommendations as to gas export were tabled in the legislature. While it was directed to the cabinet, the promptness in tabling indicated that discussion was invited and that action would not long be delayed.

The report estimated established reserves as of December 31, 1951 to be 6.8 trillion cubic feet as compared with something less than 4.7 trillion shown in the interim report of a year ago. The increase in reserves is attributed in part to new discoveries and in part to new data and new interpretation of earlier discoveries. This figure is still far short of the 8.6 trillion of proved reserves listed by DeGolyer and MacNaughton's August submission and it entirely ignores their estimates of probable and possible reserves. The report does, however, take recognition of the rate of discovery of reserves, showing that for every hundred wildcats drilled, some 400 billion cubic feet of reserves have been added, and it suggests that there may easily be added annually a trillion cubic feet of reserves over the next eight or ten years.

While raising sights on reserves, the sights have also been raised on demand by a third over the next thirty years, with an aggregate demand now estimated at 4.2 trillion cubic feet.

In spite of recognition of increased reserves and of the great probability of continuing discoveries over the province generally, the report denies that there is a surplus of gas for export throughout the province generally, but considers that reserves over and above Alberta requirements exist in the Peace River district. Established reserves in that district are set at 500 billion, and after reserving enough gas for local use, it is recommended that 300 billion cubic feet be considered available for export. Rigid limitation as to maximum daily and annual rate of export is provided for, and it is recommended that Westcoast be given permission to export from the Peace River district, and the boundaries of the district are specified. Among the provisions to be met are that the permit will be for a period of 22 years from the date of issue; export must start before the close of 1954; no gas may be exported unless by the close of 1953 gas has been made available to supply eight specified towns and villages; and not more than 165 MMcf in one day nor 42 MMMcf in one year may be exported. This provides for export of 210 MMMcf in the first five years, at the end of which time the Board is to fix the amount of annual export. All other applications for export now before the Board are denied.

Market reaction to the Board's report was bullish and for a couple of days many stocks advanced in price. The public which invests in oil and gas issues seems to feel that even so limited a permission to export gas is a forecast that greater easing of the situation may be expected before long. A portion of the report touching on Pincher Creek was most disappointing to Gulf. The report suggested that by introducing gas from that field into the Calgary supply in 1968, it would be possible to maintain peak delivery capacity, and earlier use would mean either uneconomic operation of the necessary processing and delivery facilities or more expensive gas. The report foresaw a Pincher Creek plant turning out 90 MMcf/day of consumer gas in 1968, rising to 220 MMcf/day in 1971 and continuing at that level for 10 years. Gulf promptly replied that so long a delay will retard, or even stop, a program involving an expenditure of $365 million now under way, and which has four wells about 12,000 feet deep with three more drilling. Gulf went on to point out that many other products besides natural gas will come from the field including 7.4 million long tons of sulfur; 38.4 million barrels of condensate; 9.8 million barrels of natural gasoline; 12.7 million barrels of propane, and 10.4 million barrels of butane. The comment was made that liquid petroleum gas would afford a most useful supply of fuel to farmers who are unable to obtain natural gas by pipe line.



Other operators who have been active in exploring for Alberta gas outside the Peace River district have made no public statements, but the report of the Board has been most disappointing to them, for with the great difficulty in obtaining steel and the high cost of all operations, the report seems to forecast a long period of time before such gas wells can be considered assets.

On introducing a resolution into the Legislature, Premier Manning moved that the Board's report be accepted and that a permit be granted to Westcoast on the terms suggested. He commented on the fact that the delay in utilizing Pincher Creek gas may not be as great as the 16 years suggested by the Board if other discoveries suitable to supply the Calgary system make it no longer necessary to consider Pincher Creek as essential to Alberta supply. The resolution was passed on April 10, allowing the Legislature to prorogue before the Easter holiday.

Pacific Petroleums Limited and Associates have made some gas discoveries in British Columbia adjacent to the Peace River district of Alberta from which export is now authorized. No comment has been forthcoming from the British Columbia Government respecting policy on utilization of that gas, but since the Westcoast proposal would take gas to Vancouver and other British Columbia points, apparently no political problems are involved in gathering such gas and piping it.

Some gas discoveries have recently been made in Saskatchewan, and the socialist government of that province has announced that it will purchase or pay for gas from discoveries in that province, the implication being that Saskatchewan will gather, transmit and distribute gas within the province. This does not necessarily mean that if gas were to be piped from Alberta eastward the province would refuse to take gas from the pipe line, but it does presuppose an intention that the province will act as distributors within the province.

In the United States, there is keen interest in the matter of gas imports from Canada.

A total of seven applications involving the give and take of gas between Canada and the United States is pending before the Federal Power Commission. A hearing was set for April 8, but postponed until June 16. In the light of the Canadian action, the Federal Power Commission is faced with a decision whether to go ahead with the consolidated case, as planned, or to take up only the application of Westcoast Transmission Co.

The applications before the power commission in Washington include these:

1. *Pacific Northwest Pipe Line Corp.*, which proposes $58 million worth of facilities to carry gas from the international boundary in Stevens County, Wash., down the West coast of Washington State to Portland, Ore. The gas would come from its subsidiary, Prairie Transmission Lines.

2. *Westcoast Transmission Co.*, proposing $17 million in facilities to carry gas from the boundary near Sumas, Wash., to Portland, Ore. The gas would come from its associate, Westcoast Transmission Co., Limited.

3. *Northwest Natural Gas Co.*, proposing $50 million in facilities to carry gas to the West coast of Washington and Oregon. Alberta Natural Gas Grid, Ltd., and Alberta Natural Gas Co. are its subsidiaries.

4. *Glacier Gas Co.*, Butte, Mont., a subsidiary of the Montana Power Co., which proposes a 285-mile 20-inch gas line from the boundary near Kalispell, Mont., serving Spokane, Wash., Lewiston, Idaho, and Trail, British Columbia. A gas supply from Westcoast Limited is sought.

5. *Trans-Northwest Gas, Inc.*, Spokane, which proposes a line from the boundary down the Eastern side of Washington State. The company seeks a gas supply from Westcoast Transmission Company Limited.

6. *Northern Natural Gas Co.*, Omaha, which proposes a $25 million gas pipe line of 400 miles from the boundary near Winnipeg to the vicinity of Minneapolis, Minn. The gas would come from Alberta through Western Pipe Lines of Canada.

7. *Tennessee Gas Transmission Co.*, Houston, and *Niagara Gas Transmission Limited*, Toronto, jointly proposing to carry 50 million cubic feet annually of Southwestern U. S. natural gas to Toronto, Hamilton, Ottawa, Montreal, Quebec and other Canadian communities.

While argument may be expected over the merits of the various proposals, since some of the applications are competitive, a pattern of gas supply and distribution between the two countries has been recommended at several points in the federal power commission records. This pattern as set out in the Tennessee-Niagara application to the commission, suggests:

a—Westcoast and Trans-Northwest supply Washington and Oregon with gas from reserves in Northern Alberta and British Columbia.

b—Western Pipe Lines lay a line to Winnipeg to connect with Northern Natural's proposed gas line to Minneapolis.

c—Tennessee and Niagara supply the provinces of Ontario and Quebec with gas from Texas and elsewhere in the United States.

"These three projects," says the Tennessee-Niagara document, "are the only combination of the projects now being proposed which will supply all of the markets in question.

"Moreover, each of the markets will be served by the gas reserves which are its logical sources of supply from a geographical and economic standpoint.

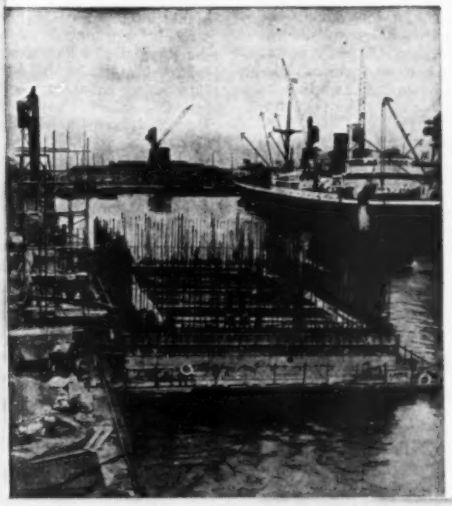
"These three projects do not involve needless international complications or any so-called reciprocal arrangements, and they can be authorized and regulated by the Canadian and United States authorities without any possible impairment of their respective jurisdictions."

In summary, then, it appears that Canada is just now exercising caution. Since new gas reserves are likely to be discovered in Alberta, it should be only a matter of time before a go-ahead for large scale exports is forthcoming. In the meantime, there is little the U. S. government can do, since a requirement for a gas company to get U. S. permission to construct a pipe line is proof of an adequate gas supply.

Oil Refinery Construction at Coryton

Placing concrete for storage tank bases

Floating 100-ton oil tanks to new positions



Water intake works constructed at Tilbury and floated to Coryton

The refinery site is below high water level of the Thames

CIVIL ENGINEERING AND BUILDING WORK is in progress at the new refinery for Vacuum Oil Company Limited at Coryton in conjunction with The Lummus Company Limited.
This project on the Essex side of the Thames involves considerable construction work in heavy foundations, roads, drainage, and a water intake works and jetty.

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BRITISH OIL NEWS

By E. Lawson Lomax

Motor Fuel Tax Increased

Following the statement of Mr. Lloyd, minister of fuel, on Feb. 27 that premium brands of fuel could not be introduced, Mr. Butler, chancellor of the exchequer, announced on March 12 that the duty on oils and spirits used as motor fuels would be increased by 7½d, from 1/10½ per gallon to 2/6. This increase will bring in an additional sum of £66 million per year. This brings the price of "pool" spirit to the country's high of 4/2¾d per Imperial gallon, of which 59.1 percent is tax.

It is not expected that this heavy tax will reduce the consumption of petroleum for road haulage, primarily because it is a necessity and secondly because this form of transport is probably the most efficient in the country; but the increase must have a large effect on the ultimate cost, and increases in the charges for this form of transport, both for passengers and goods, are almost bound to follow.

The estimated sum which the Chancellor expects to obtain from this increased tax is based on the continued operation at full capacity of the existing refineries as well as those in course of erection and due for completion in the near future. This sheds further light on the Iranian oil question, showing that the United Kingdom is no longer dependent on Persia for supplies of crude oil to feed its refineries, stepped up production in the other Middle East fields now being sufficient for that purpose.

Oil Search Progress in Papua

For many years research and survey for petroleum have continued and are still continuing in the rain-soaked delta jungle of Papua.

Thousands of square miles of territory have been surveyed both from the air, at ground level, and geophysically, the search having been carried out by the Australasian Petroleum Co. in which the Anglo-Iranian Oil Co. has an interest.

A good start was made early this year on No. 2 Well Hohoro, and 6⅝-inch casing has been successfully landed at 9,975 feet, under difficult conditions of squeezing by strata formation and loss of mud circulation.

Regent Oil Co. Ltd. Extensions

The lubricating oil storage capacity at Regent Oil Co.'s Manchester installation has been increased by the addition of six new vertical tanks with appropriate ancillary work, such as new oil lines, steam lines to the tank heating coils, and new pumping equipment.

A new 100′ x 100′ warehouse complete with loading and off-loading platforms has been built to deal with the requirements of the "Lubritection" recently launched by the company, as well as the bottle washing and filling plant.

IPC Pipeline To Banias

Iraq Petroleum Co. has announced that 250,000 tons of oil had been pumped into the new 30-inch £43 million sterling line before it reached Banias, a distance of 556 miles from Kirkuk.

The whole of the 30-inch line has not yet been completed, the last 115 miles from Haditha to Kirkuk being still incomplete, and will not be finished until the end of April. In order to accelerate deliveries to Banias, advantage was taken of the 12 and 16-inch lines off the southern fork of Haifa, which were not in use, and the 30-inch line was coupled to them temporarily. Oil deliveries from Banias are scheduled to commence by mid April, the oil meanwhile being pumped to storage. This line, when in full operation, will convey an additional 280,000 b/d of Kirkuk crude to the Mediterranean seaboard.

It is estimated that during 1952 the total production from Kirkuk will exceed 980 million barrels, which is nearly double the 1951 production.

"Auris" Crosses Atlantic

The "Auris" left Plymouth on February 26 and arrived in Curacao on March 20, and during the whole of this voyage, which was accomplished at an average speed of 7.35 knots, the only power used was that generated by her gas turbine. Diesel generators were closed down for the whole of the 3,897-mile voyage (543 hours). The performance of the turbine was remarkably consistent throughout the voyage, and there was complete absence of fouling in the principal components.

Boiler fuel of the following grade was used exclusively:

Specific Gravity	0.958
Viscosity	1,300 secs. Redwood No. 1 at 100° F.
Flash point	240° F.
Conradson value	8.6%
Sulfur	3.4%

New Shell Motor Oil

Shell has put on the market a new motor oil under the name X-100. It is a highly refined mineral oil blended with a petroleum based additive, which is stable to oxidation and thus does not easily form sludge or acids. It also protects ferrous surfaces against corrosion, thus reducing wear caused particularly under cold running conditions. Its detergent qualities keep in suspension, and finely divided, those particles of soot arising from incomplete burning of the fuel and from the lubricant itself, and prevents them from forming solid lumps to block oil-ways and filters and from settling as hard coatings or lacquers on moving parts.

Personalities

F. A. C. GUEPIN has been appointed a director of Shell-Mex & B. P., Ltd. and of Scottish Oils and Shell Mex, Ltd. in succession to the Hon. F. J. Hopwood.

Mr. Guepin, who was born in Helder, Holland, joined the Royal Dutch/Shell group of companies in London in 1929. After serving many years in various countries on the continent, he was transferred to the United States as executive vice president of the Shell Oil Co. on the west coast. In 1940, when Shell's oil operations in the U. S. A. were vested in a single company, he went to the head office in New York as senior vice president. In 1944, he returned to London to take charge of the group's northern European interests and in 1949 took over the whole of the European and North African interests.

For his services to the Allied cause during the war, he was decorated by Queen Wilhelmina with the rank of officer in the Order of Orange Nassau.

He was appointed a director and managing director of the Anglo-Saxon Petroleum Co. and the Shell Petroleum Co. in London on Jan. 1, 1950, when he was also appointed member and delegate member of the board of De Bataafsche Petroleum Maatschappij, the Hague. In June of the same year, he was appointed a managing director of the Royal Dutch Petroleum Co.

In addition, he is director of the following European companies: Shell Refining and Marketing Co., Shell Chemicals, and Shell Chemical Manufacturing Co. In the United States he is a director of Shell Oil Co., Shell Caribbean Petroleum Co., and chairman of the Shell Chemical Corp.

S. G. JARVIS has been appointed secretary of C. C. Wakefield & Co., Ltd., in succession to L. M. Broadway who has been appointed assistant managing director. Mr. Jarvis, who is 42, joined Wakefield's in 1925 and has served in a number of departments at the head office.

W. L. JONES has been appointed Scottish branch manager of Regent Oil Co., Ltd. Mr. Jones joined an oil distributing company in 1926 and in 1937 he joined the sales staff of Trinidad Leaseholds, Ltd., becoming a member of the staff of Regent Oil Co. on its formation in 1948. Since then he has been employed in various capacities with the company in its sales section.

C. T. BRUNNER, who is a director and general manager of Shell-Mex & B. P., has been elected president of the Institute of Transport for 1952-53 and will assume office on October 1. During the war he was secretary of the management committee of the Petroleum Board, and manager of the board's secretariat. He joined Shell in 1926 and was appointed assistant general manager of Shell-Mex & B. P., Ltd., in 1947. Since 1950 he has been director and general manager of the company.

F. A. C. Guepin *S. G. Jarvis* *W. L. Jones* *C. T. Brunner*

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1. Radio-frequency energy in the form of a "surface wave" is directed along the air-earth boundary toward a receiver positioned at varying distances from the transmitter.
2. As the surface wave moves toward the receiver, a progression of electromagnetic "rays" is refracted downward into the earth along substantially parallel paths.
3. Upon striking a reflecting stratum, some of the rays are refracted farther into the earth, while others are reflected upward to the surface where they are again refracted and rejoin the surface wave.
4. The combined energy of the wave sweeping the surface and that of the reflected rays returning from depth is indicated by the receiver.
5. Due to the unique electrical contrast that exists at the boundary of an oil field, where the oil frequently lies in contact with salt water, evaluation by RADOIL specialists of the combined energy arriving at the receiver will indicate the presence or absence of an oil boundary.

RADOIL is the only known method by which radio waves may be forced past the air-earth barrier to varying depths in the earth, reflected back through the same severe barrier at the surface, mixed for comparison with a surface wave, and then received in sufficient volume to be recorded and analyzed with accuracy.

The above description of the RADOIL operation is necessarily brief, with much pertinent information omitted. A more detailed explanation of the method may be had on request, as can information pertaining to contracting and licensing of RADOIL. Information is also available on RADORE, an adaptation of the RADOIL method for use in locating ore deposits.

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New Australian Refinery

Following the ratification by the Western Australia Parliament of the agreement between the State Government and the Anglo-Iranian Oil Co., Ltd., details are now available regarding the construction of a refinery at Kwinana, about 12 miles from Fremantle, with a capacity of 60,000 b/d at a cost of £40 million.

The refinery area is about 900 acres of level bare scrub, well above sea level, with good load-bearing properties and alongside deep water were large 28,000 and 32,000-ton tankers will be able to discharge.

The Western Australia government has undertaken to make the land available, to supply fresh water and electricity, to build some 1,000 houses suitable for future employees, to lay roads and railways to the site, and to carry out the necessary dredging of the water channels through the Success and Parmelia sand banks which will need widening and deepening to provide easy access for the largest tankers.

The plant will consist of atmospheric and vacuum distillation units with the usual treatment plants and also a catalytic cracking unit to enable high grade petrol to be produced.

A power house, maintenance workshops, stores, and a laboratory equipped with test engines for product control will be constructed.

Steel required for plant, structures, and piping will be 80,000 tons, of which 20,000 will be for piping alone. Other material requirements will be about 150,000 tons.

Sulfur From Petroleum

The Shell Petroleum Co. sulfur plant at Stanlow is now in successful operation, producing elemental sulfur from refinery gases. A sulfuric acid plant is to be installed by the end of the year, which in conjunction with a sludge decomposer to be erected later, will supply acid to fulfill the refinery's requirements.

Oil Search in the United Kingdom

A further exploratory well is to be drilled by D'Arcy Exploration Co. as soon as the well now being drilled at Ainsdale-on-Sea, Lancashire, which has now reached approximately 2,000 feet, has been completed.

This new well will be drilled on the Isle of Wight, almost exactly in the middle of the island, about half a mile southwest of the village of Arreton. The site was based on gravity and seismic surveys.

"Caltex Calcutta" Launched

The launching of the "Caltex Calcutta," which was sponsored by Mrs. Bramstedt (wife of W. F. Bramstedt, President of the Caltex Bahrein Group) on March 11, marked the final launching of the group of four similar tankers ordered by Overseas Tankship (U. K.) Ltd. from Wm. Doxford & Son, Ltd., Sunderland, which will form part of the fleet of nine tankers now being constructed in the United Kingdom for these owners.

Launching of the Motor Tanker "Janita"

Harland and Wolff announce the launching of the 18,500 dwt motor tanker "Janita" on March 25, built for them to the order of Messrs. Anders Jahre & Co. of Sandefjord, Norway. The propelling machinery consists of one single-acting Harland-B. & W. six cylinder two cycle engine of opposed piston design.

New Vacuum Storage Capacity

The Vacuum Oil Co. has in project new storage of 50,000 tons capacity at Sunderland, Durham, the consulting engineers for which are Mannsell, Posford & Tavey.

Petrochemicals, Ltd. Yearly Report

The consolidated profit and loss account of Petrochemicals, Ltd., for the year ended June 30, 1951, shows that the loss on the company's activities during the year was £986,063 compared with £830,889 for the previous year. This, added to the debit balance at June 30, 1950, makes a total debit of £2,025,296.

The report of the directors states that during the year under review, the company's plant and that of its subsidiary and associated companies was substantially completed. Experience gained in the course of bringing the plants into operation showed that a number of extensions and modifications were desirable with a view of improving the overall efficiency and output. This work is proceeding satisfactorily.

To provide finance for the extensions and modifications and to replace working capital absorbed as a result of unavoidable delay in completion of the plant, Finance Corporation for Industry, Ltd., has granted a further loan of up to £1,000,000.

Research and development work is being continued with a view to improving the yield, quality and range of the products.

In his statement accompanying the report, the chairman said that the average naphtha throughput during the last six months has been at the rate of 80,000 tons per year, which is above rated capacity.

The gas separation plant, which initially gave operational trouble, is now performing satisfactorily.

Continued shortage of chlorine, which has to be purchased from outside sources, has prevented full advantage being taken of the improved performance of the plants. It is hoped that during the first quarter of 1952, deliveries of chlorine will reach total requirements, with consequent improvement in the company's revenue position.

The associated and subsidiary companies have continued to make satisfactory progress.

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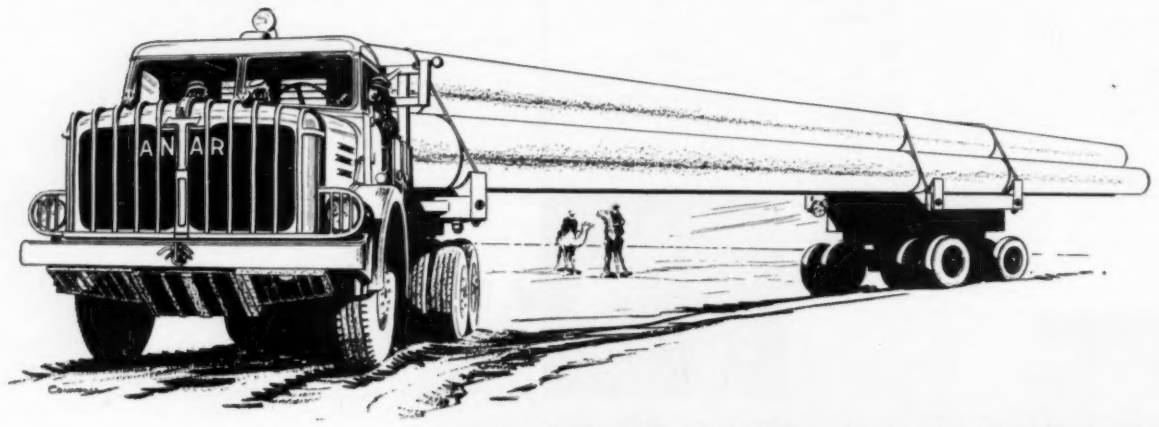

One of a large fleet of 60 ton pipe carriers loaded with pipes approximately 93' long, 2'8" diameter and weighing 6¾ tons each, and employed on the Middle East oil project for the Iraq Petroleum Co., Ltd., between Homs, Syria and Haditha in Iraq.

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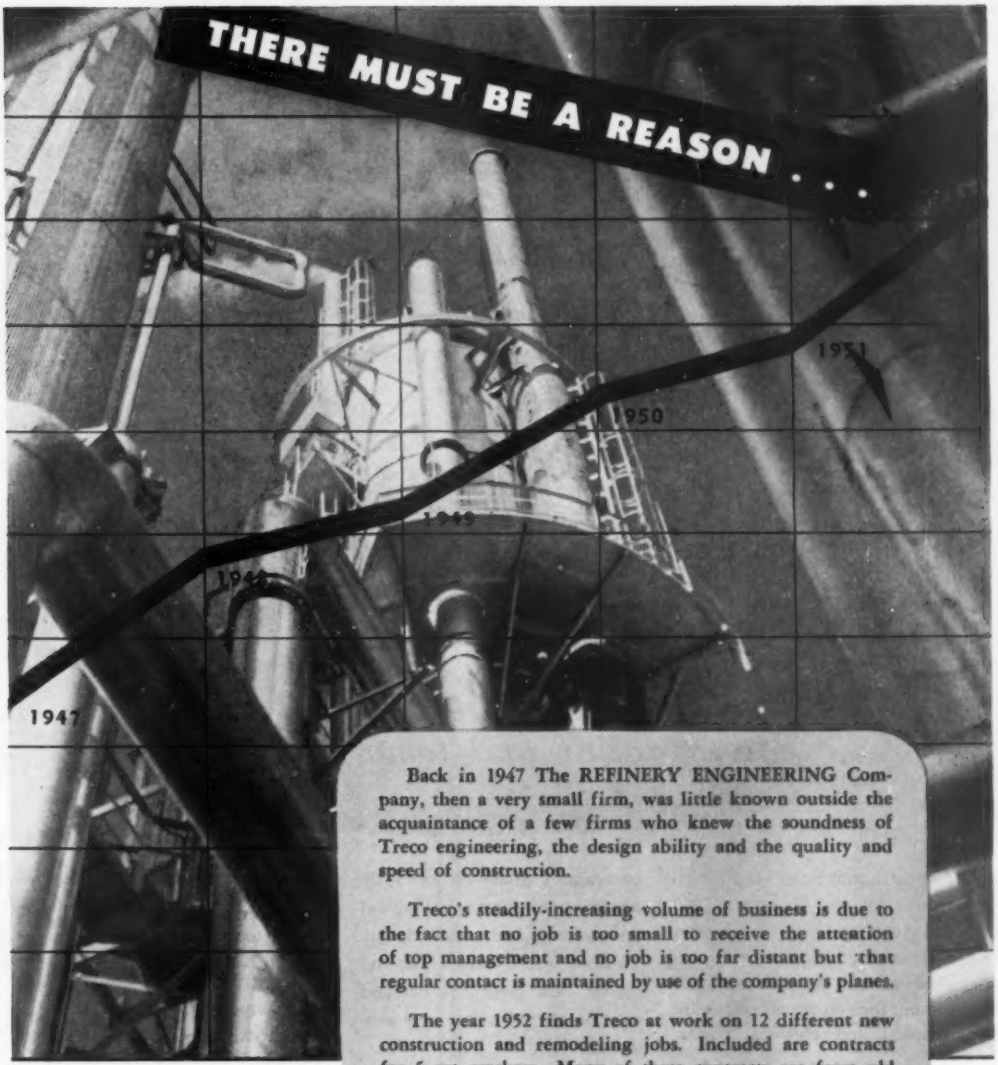

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The year 1952 finds Treco at work on 12 different new construction and remodeling jobs. Included are contracts for 5 cat crackers. Many of these contracts are from old customers, which all goes to prove that *there is a very good reason why Treco continues to grow.*

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What's more, the plants must have the flexibility to answer needs of the future. Engineering ingenuity at Lummus concerns itself with taking every precaution today against a future time when outmoded tools may put you at a competitive disadvantage.

That sums up our interpretation of judicious spending. Over six hundred soundly-designed, profit-producing plants have been built on this steadfast concept. You may wish to bear these facts in mind on *your* next project.

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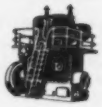

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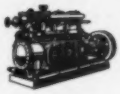

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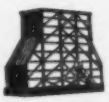

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Drilling Active in Venezuela

Drilling activity continued to rise to new levels in Venezuela, with 111 rigs operating in March, as compared with 108 in February and 87 in March of 1951. With 26 rigs on exploration drilling, significant wildcatting was being carried out in all sections of the country.

In Western Venezuela, Texas was drilling Dabajuro wildcat DX-2 for Creole's account, with the hole at 1,600 feet as April began. This was the only wildcat in the State of Falcon. Also on the west side of Lake Maracaibo, Shell was drilling Boqueron BQ-1 at 2,000 feet in the mountains near Valera; their Pueblo Viejo deep test LS-1387 was drilling at 11,500; while VL-5, in the waters of the lake, continued to work stuck pipe at a total depth of 7,500 feet. On the east side of the lake, Shell was fishing at just under 13,000 feet in Concepcion C-149. Concepcion C-151 was drilling near 7,300 feet, while C-150 was temporarily suspended at 13,200. Mene Grande had carried 1-MXZ-2, on former Orinoco Oil Co. acreage northwest of the Mara field, to 8,500 and was testing. The same company had also begun a workover of Calentura-2, suspended by Orinoco some years ago below 9,000 feet, and was preparing to deepen it in the hope of encountering Cretaceous production. Richmond's Perico-1, on the Colombia side of the Goajira Peninsula, was abandoned in early March at near 11,200 feet. Shell was preparing to spud a test near Burgua, in the mountain state of Tachira, where no drilling has taken place for many years. Near the city of Maracaibo, Shell was drilling at 10,500 in Sibucara-7 and at 4,300 feet in Sibucara-9, spudded immediately following the completion of Sibucara-8 for about 4,000 b/d from the Cretaceous.

In Guarico (Central Venezuela), where no fields of importance have yet been found, three operators were carrying on the search for oil as April began. Atlantic abandoned Tamanaco-1 at 4,400 and Monal-21 at 3,850 feet without running casing, but was drilling ahead on Guama-2, north of Tucupido, at 7,154 and Retumbo-2, in southeastern Guarico, was testing at 5,350 feet. Texas-Mercedes temporarily abandoned Punzon-5 at 5,288, but had Punzon-6 drilling at 4,000 feet, Valle-5 at 5,147, and was coring in Mercedes-175 at 5,200 in search of a deeper pool, while Palacio-71 was testing for a new pool at 3,500 feet. Sinclair drilled Las Rositas-1 to 4,400 feet in a second attempt to find production west of Atlantic's field, but abandoned the hole as dry. Alacran-1, near the town of Zaraza, reached final depth of 7,800 and was preparing to test in early April. Phillips meanwhile was putting down GC-1 at 4,000 feet about two miles east of the Ruiz field.

In Eastern Venezuela, Creole's Pedernales PCA-22 was completed at 9,500 feet as a small producer, and a joint Creole-Seaboard test PSX-3 was begun in the same area. Although the location was on mainland, the terrain was so soft that a channel was dug to permit drilling from a barge. This hole was at 115 feet in early April. Guanoco-2, near the old asphalt lake of the same name, was testing at 8,600. The joint Creole-Atlantic new field test Cachipo-1 was drilling at 6,400 at a point four miles east of the Quiriquire field. In Quiriquire field, deeper-pool test Q-533 was testing at 8,500. The Phillips wildcat Ana-1 was coring at 9,800 in the Santa Ana area. Texas test Rincon-5 was drilling at 8,000 feet. In the same general area, Socony's Cantaura-1 was completed near 12,000 feet as a new-field discovery, and the rig moved southeast to drill Oscurote-1, about 2 miles from Mene Grande's 1951 find, Chive-1. The Texas Co. was preparing to test Mata-5, at 12,500 feet the third deepest hole in eastern Venezuela, and was drilling at 10,500 on new-pool test Mata-3. Mene Grande Oil Co. suspended operations temporarily at deep test La Vieja-1, 11,750 feet, and was preparing to abandon Barba-1 at under 8,500 near Santa Barbara. Meneg's Greater Urica wildcat Divi-1 continued to drill near 9,800 feet, and Quiamare QXG-3 was below 9,200 and drilling ahead. Meneg's Rita-1, in the north Nipa area, was testing at 10,100 feet, and SXM-101 was very successfully completed as a dual-zoner, opening up a new area to be known as East Boca. Leona LXG-301 was spudded by Mene Grande near the end of March as was Caico Seco CaXZ-501. SCJ-2, second well in the field opened up by Tapuco-1, uncovered a number of new sands and was completing as a dual-zone well as April began.

February's production averaged 1,828,421 b/d, for an all-time high. The average for 1952 in Venezuela thus far is 1,819,781 b/d, as compared with 1,704,643 for the year 1951. Figures for February are not yet complete, but January's breakdown by operators is as follows:

	Eastern Venezuela	Western Venezuela	Total
Creole	130,200	638,886	769,086
Shell Co.'s	.....	571,658	571,658
Mene Grande	245,184	58,454	303,638
Socony-Vacuum	52,703	.....	52,703
Texas-Mercedes	34,477	12,219	46,696
Atlantic	17,936	.....	17,936
Richmond	.....	15,833	15,833
Sinclair	14,063	.....	14,063
Phillips	10,614	.....	10,614
Pantepec	8,512	.....	8,512
BCO, Ltd.	.....	941	941
	513,689*	1,297,991	1,811,680

*Includes 42,152 barrels from State of Guarico.

March gives promise of continuing the upward trend now so firmly established. In one week of early March, daily production averaged upward of 1,835,000 barrels.

Exploration in Venezuela

Exploration parties worked a total of 44 party months in Venezuela during January. The greatest concentrations of activity were in the States of Falcon (7 party months), Anzoategui (6.5), Guarico (5) and Zulia (5). Geological surface exploration accounted for the greatest number of parties (20), seismograph for 18, and gravimeter and structure drill for 3 each. Shell operated the largest number of parties (14), Creole was next with 8, and 7 other companies had anywhere from one to four parties in the field. Activity in January was 10 percent greater than in December. New projects or changes of location totaled 11.

Refinery Runs

Venezuela's refinery runs were averaging about 362,000 b/d in late February. The Shell companies were obtaining 146,000 b/d of refined products at Punta Cardon and 43,000 b/d at San Lorenzo; Vengref was running about 36,000 b/d at Puerto la Cruz; Creole's Amuay plant was producing about 80,000 b/d, while the Caripito unit was turning out 70,000; and the Sinclair plant at Puerto la Cruz was handling some 30,000 b/d.

Bermudez Recounts Progress of Mexican Industry

Progress of the Mexican petroleum industry was recounted by Senator Antonio J. Bermudez, director general of Petroleos Mexicanos, at the recent luncheon given in his honor at Dallas by John B. O'Connor, executive vice president of Dresser Industries.

There are now 44 geophysical crews operating in Mexico, he reported. Reconnaissance work has outlined 150 structures which are waiting to be drilled. With only 111 drilling and workover rigs operating, there are many locations which cannot be tested immediately.

Pemex has discovered four major fields since Senator Bermudez took over operation of the company. The two major oil fields are Poza Rica and Jose Colomo, and the gas fields Reynosa and Brazil. Other fields of somewhat lesser importance have been found and are under development. Mexico now is producing 230,000 barrels of oil and has available 315 million cubic feet of gas daily in northern Mexico and a similar quantity in southern Mexico. Some gas is available for export to the United States and more is being developed.

Senator Bermudez reported that Pemex has built more than 1,000 miles of pipe line in the past five years, one line linking the Atlantic and Pacific oceans.

Since 1946 the nation's refining capacity has been increased from 160,000 to 223,000 barrels daily, and further expansion is in progress. Oil plants are being modernized in addition to the new plants being erected.

Last year Pemex drilled 267 wells, of which 59 percent were drilled by company rigs, and 41 percent by independent contractors.

Senator Bermudez pointed out to the oil men in Dallas that Mexico is now the No. 1 customer of the United States in the entire world. He pointed to the growing friendship between the two nations with its unguarded border, without fortresses and without soldiers.

Luncheon given by John B. O'Connor, executive vice president, Dresser Industries, Inc., host to Senator Antonio J. Bermudez, director general, Petroleos Mexicanos (Pemex), the government-operated oil company of Mexico.

OIL AND THE WATERFALL

THIS 22-million-gallon-a-day "waterfall" in one of the cooling towers at Anglo-Iranian's oil refinery in South Wales is part of an expansion project that has already raised the refinery's production to twelve times its pre-war rate.

This in turn forms part of a greater expansion programme on a world-wide scale. Anglo-Iranian and its associated companies operate nine refineries in the United Kingdom, France, Germany, Italy and Australia. A tenth refinery recently went on stream in Belgium and another new refinery is under construction now in the United Kingdom.

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W. G. Skelly

W. B. Way

To Invite Oil Men from All Nations

The United States Department of State and the Nomads organization will again invite visitors from the oil producing countries of the world to attend the 1953 International Petroleum Exposition May 14-23 at Tulsa, according to W. G. Skelly, President.

Harry E. Estes of the A-1 Bit & Tool Company, Houston, executive secretary of the Nomads national board of regents, is heading the Nomads exposition committee. Sub-committee to handle various phases of the Nomads participation will be appointed within the next 30 days by Mr. Estes who will be assisted by members of the board from the New York, Dallas, Los Angeles, Houston and Tulsa chapters.

The State Department is to issue invitations to the various countries through diplomatic channels, Mr. Skelly announced.

Oil men from 43 countries outside the United States attended the last show held in 1948. The countries were Africa, Algeria, Arabia, Argentina, Belgium, Bolivia, Brazil, Canada, Canal Zone, Chile, China, Colombia, Cuba, Dutch East Indies, Egypt, England, Ecuador, France, French Morocco, Germany, Guam, Holland, India, Iran, Iraq, Italy, Java, Lebanon, Mexico, Netherlands, Palestine, Paraguay, Peru, Philippines, Persian Gulf, Romania, Russia, Scotland, Switzerland, Trinidad, Turkey, Uruguay, and Venezuela.

Over 1,000 individual exhibitor companies, with attendance from every oil producing state of the Union as well as the 43 countries listed, participated in the 1948 Exposition.

The 1953 Show office was opened April 1st, with a full office staff to serve exhibitors, said Wm. B. Way, General Manager.

Mexican Sulfur Prospects

Mexico's sulfur production can rise to 1,000,000 tons annually, in the opinion of U. S. oil observers in Mexico City. The 1,000,000-ton figure is calculated upon estimates that the Woodley Petroleum Co. can produce 500,000 tons a year from its Jaltipan and Coatzacoalcos operations; Petroleos Mexicanos some 60,000 tons this year from Poza Rica; and next year, when sulfur installations at Ciudad Madero and Azcapotzalco are complete, 200,000 tons.

Other companies active in the Mexican sulfur picture, but for which production estimates are not available, include Mexican Gulf Sulfur, operating at San Cristobal de Coapapan; Texas Gulf Sulfur, on the Isthmus of Tehuantepec; and an unidentified Delaware corporation at Sayula, in the State of Veracruz.

West Australia Oil Search

West Australian Petroleum Proprietary Ltd. has been formed by California Texas Oil Co. and AMPOL to explore over 350,000 square miles of virtually desert country in Western Australia. Some preliminary geological work has been carried out, and the joint companies' first field party recently returned from the area. With the information they have obtained, they will recommend the exact site of drilling for the first well, and the route and methods of transporting heavy equipment including complete rotary drilling rig, line pipe and casing, power plant, specialty tools, drilling mud equipment, logging, cementing, laboratory and camp equipment for 50 men, food, stoves, medical supplies, etc.

West Australian Petroleum's initial goal is the drilling of one well at a location some 800 miles from the nearest deep water port, Fremantle.

Aerial view of last International Petroleum Exposition held in Tulsa in 1948.

$17 Million Medical Cost

During the year 1951, the Shell companies maintained a medical department of 600 persons supplying medical services in Venezuela to a group of more than 62,000 persons, composed of Shell workers and their families, at a total cost of some $17 million.

Backbone of the medical staff consists of 66 doctors and 99 graduate nurses. There are also 17 pharmacists, 14 laboratory technicians, eight X-ray specialists, 179 nurses' aids, and lesser numbers of other workers. Five hospitals are maintained: at Maracaibo (72 beds), Cardon (60), Lagunillas (45), Mene Grande (22), and Casigua (12). There are also seven dispensaries in the Bolivar district and four in the Concepcion area, besides those at Cardon and Caracas.

During 1951, the medical department gave a total of 208,480 consultations which resulted in 320,841 medical treatments. Patients hospitalized numbered 4,729 (an average of 11 per day), for an average of 8½ days each. Major and minor surgery accounted for 4,172 operations. Over 126,000 laboratory analyses were made, and technicians took 23,845 X-rays and 9,435 radioscopes. Advances made in the fields of hygiene and preventive medicine have attracted the attention of public health officials throughout the country.

First Fire in 30 Years

Photo of Standard Vacuum Petroleum Maatschappij wildcat test blowout in Sumatra which burned for 86 days before being brought under control.

Since 1912, Standard-Vacuum Petroleum Maatschappij has drilled more than 1,400 wells in Sumatra. It prides itself on its conservation practices and on the safety record of its production department in a game which is always potentially dangerous. In nearly 30 years, not a single well fire had occurred during normal operating periods.

Last December SVPM's enviable record was broken. A wildcat test suffered a blow-out, caught fire, and for 86 days flames up to 150 feet high raged unchecked, melting the steel derrick and burning the escaping gas at an initial rate of some 30 million cubic feet per day.

The fire was eventually brought under control by drilling two relief wells within 200 feet of the wild well and flooding gas strata between 500 and 600 feet below the surface. No outside fire-fighting experts were required—SVPM's own field staff handled the job.

Withdraws From Argentina

Ultramar Oil Co. has decided to withdraw from the Argentine market, selling its property here to the government. Ultramar was formed 19 years ago as a merger of the Argentine interests of Socony-Vacuum Oil Co. and Texas Co.

BOOKS

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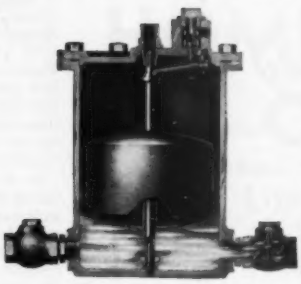

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Left: Cleaning wire rope with a wire brush and applying a preservative before storing after use.

Below: An oil-bath for the fibre cores of wire rope, during manufacture.

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Vargas Urges Mixed Company to Develop Brazilian Oil

In his recent annual message to Congress, President Vargas of Brazil again recommended formation of a mixed company with investment by both private capital and the government. He appealed to the law-makers for an early decision.

Although the National Petroleum Council is doing its best to develop Brazilian oil resources, it is handicapped by limited funds and technical resources. The task ahead is a formidable one.

From a refining standpoint, the Mataripe refinery capacity, now being increased to 5,000 barrels daily, will be in a position to supply the needs of Sergipe, Alagoas and part of Pernambuco towards the end of 1952, and the 45,000 barrel refinery at Cubatao should begin operating before the end of 1953. Work is also being accelerated on the amplification of the Ipiranga plant, in Rio Grande do Sul, and on the installation of privately-owned refineries for 10,000 and 20,000 barrels in the Federal District and S. Paulo. At the moment, the Council is studying applications to build refineries at various points in Brazil, in accordance with a general plan to which future policy must conform. The first products line between Santos and S. Paulo began carrying gasoline, kerosine and diesel oil last year. In 1951, also, Brazil's first two tankers were brought into service and the small units ordered from Japanese yards began to arrive.

As regards prospecting, geologic and geophysical research in 1951 embraced sedimentary areas in Amazonas, Para, Maranham, Pernambuco, Alagoas, Sergipe, Bahia, S. Paulo, Parana, and Santa Catarina. Investigations are still proceeding at Abacaxis, Paratari and Maues, in eastern Amazonas; at Acarapireira, on Marajo Island; in southern Maranham at Balsas and Carolina, and in the north in the San Luis district; between Piracuruca, in Piaui, and Ipueiras, in Ceara; in the Pojuca and Reconcavo districts of Bahia; in the Angatuba and Guarei-Conchas-Porangaba zones of S. Paulo; and in the Reserva-Castro-Prudentopolis region of Parana.

Drilling operations were speeded up in 1951. From the start of its activities until December 31 last, the Council had opened 288 wells. Of these, 137 are producing oil and 22 gas (all in Bahia), 57 are dry, 19 are stratigraphic, and three are exhausted. At present five wells are being drilled in Bahia, one in Sergipe and one in Para. The Council's 16 drills are operating in Bahia, Para, Maranham and Sergipe. The test well begun in 1950 at Limoeiro, Para, on the bank of the Tocantins River, proved dry and was abandoned last year, after reaching a depth of 13,200 feet. The modern rig employed on this operation was then transferred to Curura, on Marajo Island, and the well which it began drilling on October 23 has reached a depth of 6,700 feet.

In Maranham, after prolonged geological investigations, the site was selected for the first well near Carolina, on the Goias border. This proved dry and was abandoned in 1951 at a depth of 5,450 feet. The Council is now considering the relative advantages of drilling a second well in the same structure or transferring the rig to another zone presenting favorable characteristics.

Three test wells were opened up during 1951 in Sergipe, one at Japoata and two near Japaratuba. All these proved dry, and in December work was started on a fourth, near Japaratuba, which has reached a depth of 600 feet. Within the next few days test drilling will start at Angatuba in the State of S. Paulo.

During the 12 months ending December 31, the Council completed three wells, drilled 30 others and deepened two; 31 were in Bahia, one in Para, one in Maranham and two in Sergipe, the total depth amounting to 78,500 feet. Of the Bahia wells, 19 yield oil, five gas and seven are dry.

The development of geological and geophysical prospecting in Bahia resulted in the discovery of new fields at Agua Grande and Paramirim do Vencimento in 1950, and of new producing areas at Pedras and Mata de Sao Joao in 1951. The reserves of the Bahia oilfields are now estimated at 50 million barrels. The potential output is about 20,000 barrels daily, MER is 7,000 b/d.

The Bahia fields yielded 690,776 barrels in 1951,

or 352,069 more than in 1950, the difference being mainly due to the regular supply of 2,500 barrels daily to the Mataripe refinery. The natural gas of the Aratu field in Bahia is sold under contract to the East Brazil Railway for electric power generation. Part of the Itaparica gas is sold to a local cotton factory. The gas reserves are calculated at 42,300 million cubic feet.

Bituminous shales of the Paraiba Valley are now undergoing tests in the United States in order to determine the best recovery processes. Shale operations now are under the jurisdiction of the National Petroleum Council.

Creole Earns $202 Million

Creole Petroleum Corp. reported to its stockholders in late March that the net earnings of the company in 1951 totaled $202,278,299 and that the Venezuelan nation's net from Creole operations was the even higher figure of $206,000,000, in the form of exploitation taxes (or royalty), income taxes, import duties, and other taxes. The government's income was up 23 percent from the 1950 total of $168,000,000, while Creole's net increased 21 percent from 1950's $167,000,000.

Creole's net production plus purchased royalty oil averaged 758,025 b/d for the year, an increase of 13.4 percent over 1950; and was averaging over 800,000 b/d in the last months of the year. Creole refineries in Monagas and Falcon had a daily throughput of 126,799 barrels, as compared with 113,164 in 1950. Toward the end of the year, the refineries were running 139,000 b/d.

To improve and expand its facilities, the company invested $54 million in 1951, or $11 million more than in 1950. Most of the reinvested capital was spent for drilling new wells and expanding Creole's crude transportation system. In respect to 1952, President A. T. Proudfit said in his letter accompanying the report, "Present plans provide for moderate expansion of Creole's operations in 1952. However, with the normal decline of producing oil wells, it is estimated that more than 70 percent of the drilling program will be required to maintain the present record volume."

Creole, the report said, continued intensifying its training program to prepare an increasing number of Venezuelans for higher positions within the organization. Fluctuation in total jobs offered by Creole during 1951 was not significant. Total employment at the end of 1951 was 14,535 persons, as compared with 14,544 at the end of 1950.

During the year, Creole made direct wage and salary payments to employees amounting to $59,354,000 as compared with $53,994,000 in 1950, part of the increase being attributable to the terms of a new Collective Contract signed on labor's behalf in early 1951. An additional $47,007,000 was charged to the payroll for indirect benefits, such as medical care, subsidy of foods sold in commissaries, sickness and accident benefits, savings and retirement plans, etc. For the same benefits, the cost in 1950 was $42,251,000.

More Passenger Cars in Germany

On October 1, 1951, a total of 2,640,479 motor vehicles was running in western Germany, 6.3 percent more than on July 1st and 23 percent more than a year ago. A further 58,777 motor vehicles are licensed in West Berlin. At 723,925, the number of passenger cars running in the Federal Republic has for the first time surpassed that of the last pre-war year 1938 (714,458) for the whole of Germany.

Stock Oversubscribed

Souris Valley Oil Co., Ltd., Winnipeg, with leases in Manitoba and Saskatchewan, recently sold a new issue of a million shares of common stock to obtain development funds. Nesbitt, Thomson & Co. of Montreal handled the offering, which was oversubscribed. The Souris company has title to leases on 128,000 acres in the Canadian side of the Williston basin, and is seeking to perfect title on some 20,000 additional acres.

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Venezuelan Reports

PRODUCTION RISES: Daily crude production in Venezuela during December averaged 1,776,374 b/d, an increase of 22,000 b/d over November. Output of various operators follows:

	Barrels Daily		
	Eastern Venezuela	Western Venezuela	Total
Creole	131,746	630,741	762,487
Shell Co.'s	.....	567,933	567,933
Mene Grande	227,243	59,211	286,454
Socony-Vacuum	54,247	.....	54,247
Texas-Mercedes	33,523	14,580	48,103
Atlantic	18,032	.....	18,032
Sinclair	13,272	.....	13,272
Richmond	.....	8,865	8,865
Pantapec	8,672	.....	8,672
Phillips	7,361	.....	7,361
BCO, Ltd.	.....	948	984
	494,096*	1,282,278	1,776,374

* Includes 41,884 bbls. from State of Guarico.

The average for December of 1950 was 1,621,767 b/d, or 150,000 barrels less. This trend was continuing into 1952, with a new high figure of 1,830,000 b/d recorded in one week of late January.

NEW FREE PORT: The Ministry of Public Works has signed a contract with Raymond Concrete Pile for the construction in two stages of facilities for a new free port on the western side of the Paraguana Peninsula. Oil companies with important refinery and loading terminal installations on the Peninsula have contributed a third of a million dollars toward the project, in return for certain facilities conceded them by the Government. This will be the first "planned" port in Venezuela, in the sense of its being designed for future expansion. In recent years, Venezuela has had to spend vast sums of money to enlarge the port of La Guaira, which had grown up haphazardly since colonial times.

DRILLING HIGHLIGHTS: Western Venezuela-Creole's new-pool test CU-136 in the high-gravity Cumarebo field of Falcon was abandoned at under 5,000 feet when it proved impossible to sidetrack. Another try will be made here later. Meantime, the Texas Co. spudded DX-2, a new-field test in the Dabajuro area of Falcon, for Creole's account. Shell was drilling at less than 1,000 feet in Boqueron BQ-1, in the mountains near Valera; coring near 11,000 feet in the Pueblo Viejo deep test LS-1387; coring near 7,600 feet in Ballenato-2, north of Mene Grande field; and working stuck pipe at 7,500 in VL-5, out in Lake Maracaibo. LB-953, a shallow new-pool test, was plugged and abandoned.

On the other side of the Lake, Shell completed Sibucara-8 for nearly 4,000 b/d, and immediately started on No. 9. Sibucara-7, meanwhile, was sidetracking at 11,000 feet, with original bottom at 14,000. Shell's Cretaceous test C-150 was testing at just under 13,000 feet, while C-150 continued to drill below 12,000. West Tarra-14, near the Colombia border, was completed from 5,000 feet, a shallow depth for this 8,000 to 9,000-foot field. Mene Grande's 1-MXZ-2, on acreage bought from the Orinoco Oil Co. a few years ago in an area west of the Mara limestone field, was drilling near 7,000 feet. Richmond's Perico-1, on the Colombian side of the Goajira Peninsula, was drilling below 11,000 feet as March began.

In Central Venezuela (Guarico), Venezuelan Atlantic continued drilling on wildcat Tamanaco-1, in acreage unsuccessfully tested by Creole some years ago below 5,000 feet. Saban SAGX-17 was completed as a new-pool discovery. Atlantic also spudded Guama-2, north of the Tucupido field. Guama-1 was drilled two years ago, but mechanical difficulties made testing inconclusive. Atlantic went back into the Monal field, where it

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had two successes and a string of dry holes, to drill Monal-21. Monal-21 is more or less an outpost of Texas's recent Dakoa field. Sinclair continued drilling at about 3,000 feet on Alacran-1, south of the town of Zaraza, and scheduled another exploratory hole, La Rositas-1, west of Atlantic's Ruiz field. Sinclair has already had one dry hole in this area. Texas-Mercedes non-development wells in Guarico included Punzon-5, coring at 5,000 in early March, and Dakoa 8-5, west of Tucupido field. Dakoa 8-4, bottomed at 3,800 feet, was to be completed with a service rig.

In Eastern Venezuela, the wildcat Tonoro-2 (jointly operated by Creole, Atlantic and Phillips) was abandoned at just under 11,000 feet. The rig was moving to Cachipo-1 to be a joint test for Creole and Atlantic account. Quiriquire-553, a deeper-pool test, continued coring below 8,000 feet, and Pedernales-PCA-22 reached 9,500 feet and was preparing to test. Phillips spudded a wildcat, Ana-1, in the general Santa Ana area, which was drilling near 8,100 as March began. The Texas Co. spudded Rincon-5, its first hole in the Rincon Largo field in some years, as a new-pool test of the eastern part of the concession. Socony's Cantaura-1, in this same Greater Anaco region, was testing with some success at final depth of 11,694 feet. Farther south, in the Greater Oficina region, Texas new-pool tests Mata-5 and 3 were coring below 12,000 and drilling below 9,200, respectively. Mene Grande Oil Company's seven rigs on wildcats were widely dispersed. Its northern, or Greater Urica, tests included Divi-1, drilling at 9,400; La Vieja-1, drilling at 11,735; and Quiamare QXG-3, drilling at 8,318. In Greater Santa Barbara, Barba-1 was drilling at 7,700 feet. In Greater Oficina, Meneg's Rita-1, in the north Nipa area, was drilling at 8,700, while north Chimire SXM-101 continued making hole at 8,600 feet.

Study Mexican Equipment Needs

A group of U. S. Government officials is currently in Mexico, as the guest of Pemex director Antonio J. Bermudez, with the supposed object of determining the country's equipment needs. The delegation includes Lester M. Carson and Louis Perry, of the Office of International Trade; George Knight and Albert Laguer, of the Petroleum Administration for Defense; and Nestor Ortiz, of the State Department. They are accompanied by Samuel B. Schoelman, Pemex Washington representative. Pemex is planning to embark upon an expansion program calling for increased purchases of foreign machinery.

Oil Well Fire in Venezuela

A spectacular oil well fire which had raged unchecked for five days in the Las Mercedes oil fields of Sociedad Anonima Petrolera Las Mercedes in Venezuela was extinguished recently by dry chemical fire extinguishers in exactly fifty seconds. It is believed to be the largest oil well fire yet extinguished by dry chemical. It was the second time in a little more than a year that such chemicals had put out a major oil well fire in Venezuela. In 1950, a five-hour fire in another company's oil fields was put out in less than one minute, after all other methods had failed.

The Las Mercedes fire occurred when an electric spark freakishly ignited some surface gas. The resulting blowout around the outside of the well casing tossed mud, rocks, water and gas 30 feet into the air. Preliminary attempts at extinguishment by foam, water, and carbon dioxide failed, and by the morning of the fifth day a crater 50 feet in diameter and 25 feet deep had formed where the drilling rig once stood.

Bulldozers threw up a large dike in a semi-circle around part of the crater, and six Ansul dry chemical units were placed in a semi-circle behind the earthen dike. Fifty seconds after the fire was attacked with dry chemicals, it was out.

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OIL COMPANY STAFF CHANGES

CHARLES R. BLYTH has been elected president of Wilshire Oil Co. following sale of a controlling interest in the company to B-L and Associates, Inc. and Lehman Brothers. Heirs of Alfred and Victor Machris sold their stock but George L. Machris, former president, is retaining his interest and continues as a director. Maurice Machris also will continue to be active.

MARSHALL SITTIG, technical writer, and Patricia Lynn Brown, literature researcher, have joined the information division of the Ethyl Corp. research laboratories at Detroit. Mr. Sittig was formerly with the engineering division of Chrysler Corp. in Detroit. Miss Brown was formerly a research associate at Albany Medical College.

PALMER C. TALBUTT, general sales manager of the Ashland Oil & Refining Co., has been elected a director. Mr. Talbutt joined Ashland as a cracking plant operator at the Catlettsburg refinery in 1926, and was later made superintendent of cracking operations and then assistant refinery superintendent. In 1930 he transferred to sales.

JOHN C. SAMPLE has rejoined the General Petroleum Corp. after an absence of three years to become assistant to the president. He returns from the Standard-Vacuum Oil Co. in New York where he has been in charge of that organization's marketing activities in South Africa, Australia, New Zealand, and Japan. From 1938 to 1949, when he went to Standard-Vacuum, he was with General Petroleum as vice president and director of marketing. Before 1938 he had spent 17 years in foreign marketing work with Standard-Vacuum and its forerunners.

DR. GEORGE E. HINDS has been appointed assistant to the manager of Continental Oil Company's petrochemical department, with headquarters in Houston. Dr. Hinds was until recently director of technical coordination for Sharples Chemicals, Inc. While in Philadelphia, Dr. Hinds held the position of assistant to the vice president in charge of the firm's technical publications and product advertising.

J. E. TOUSSAINT has been named vice president of Standard Oil Co. of Calif. by the board of trustees. A veteran California oil man, Mr. Toussaint has been general manager of the company's producing department for the past seven years. His history with Standard of California goes back 30 years to his graduation from the University of California in 1922 when he joined the company as a construction engineer in the Richmond refinery. He was named general manager of operations for California Standard's producing department in 1941, and was selected to head that department in 1945.

THOM H. GREEN, formerly research geologist for Sunray Oil Corp., has been transferred to the company's general office in Tulsa as division geologist in charge of Sunray's Gulf Coast operations. Mr. Green joined Sunray in 1948 as district geologist for Western Oklahoma, having been previously associated with another oil company as geologist and geophysicist.

JAMES E. SEEBOLD has been promoted to assistant manager of research of Standard Oil Co. (Ind.) with headquarters in the general office at Chicago. Robert A. Steel has been promoted to succeed him as director of the process division at the company's Whiting, Ind., research laboratories. Dr. Seebold joined Standard in 1940 as a chemical engineer at Whiting. He became director of the process division in 1950.

DR. CHARLES L. SMITH has been promoted by Ethyl Corp. to the newly-created post of associate director of product development in charge of agricultural chemicals. He will assist William T. Hack, director of product development. Prior to joining Ethyl, Dr. Smith was technical advisor to the National Agricultural Chemicals Association.

THOMAS SLICK has been elected a director of Dresser Industries, Inc. He is one of two sons of the late Thomas Baker Slick, Sr., discoverer of the Chusing field. He is chairman of Slick Airways, Inc., which he founded at 30, after World War II, and has since built into the largest scheduled domestic carrier of air-freight in the nation.

JOHN B. HANNA has been named general superintendent of the new refinery which Standard-Vacuum Refining Co. of South Africa (Pty.), Ltd., will build at Durban, Union of South Africa. He moved his family from their Mountainside, N. J., home to Durban in April when actual construction of Stanvac's $17 million project was scheduled to start.

Until recently, Mr. Hanna was supervisor of maintenance and construction at Esso Standard Oil Company's Bayway Refinery. He joined Esso Standard in 1935, and transferred to the Standard-Vacuum Oil Company's South African affiliate early this year.

PAUL J. ANDERSON of the producing coordination department of Standard Oil Co. (N. J.) has been appointed to the newly created position of Middle East advisor. Joining the Jersey Standard organization as an attorney in 1934, Mr. Anderson served as shareholder's representative in Egypt from 1948 through 1950. Since then he has been chairman of the company's Middle East committee. During his service with the company, he has also been assistant manager of Creole Petroleum Corp. in Venezuela, and president of the Standard Oil Co. of Chile.

E. R. LAMINACK, training director at the Beaumont, Texas, refinery of Magnolia Petroleum Co., has been appointed manager of training activities for Socony-Vacuum Oil Co., Inc., at New York. He has been a member of the industrial relations staff of Magnolia's refining division since October, 1944. Prior to that he had held various positions at the Beaumont refinery, among them stillman, shift foreman and night superintendent.

DR. FREDERICK L. MATTHEWS has been appointed technical director of the research section of the Socony-Vacuum Oil Company's laboratories at Paulsboro, N. J. He has been director of research of the Merrimac Division of Monsanto Chemical Co., Boston, since 1948.

He joined Monsanto in 1939 in the organic research division. He was made associate director of research in the Merrimac division in 1947 and director the following year.

CLYDE P. MUMMA has been named manager of the eastern Pennsylvania marketing region of the Atlantic Refining Co. Mr. Mumma has been serving as special merchandising assistant at the company's main offices in Philadelphia. He first became associated with Atlantic in 1932 as a commercial salesman in Allentown, Pa.

HERBERT A. HEMPHILL, widely known geologist in West Texas and veteran of 22 years experience there, has been appointed president of Texas Eastern Production Corp., wholly owned subsidiary of Texas Eastern Transmission Corp. Mr. Hemphill has resigned from Magnolia Petroleum Co. at Midland to accept this new post.

In his new position Mr. Hemphill will locate in the main offices of the production corporation in the Republic Building, Houston, which offices will be moved to the San Jacinto Building in Houston when that building is completed.

A. P. FRAME has returned to his post with the Cities Service organization after eighteen months of service on loan to the Petroleum Administration for Defense in Washington, D. C. He resumes his office as president of Cities Service Research and Development Co., and vice president of the Cities Service Refining Corp. and Cit-Con Oil Corp. In addition, he has been elected first vice president of Cities Service Petroleum, Inc. (formerly Petroleum Advisers, Inc.) the coordinating company for the petroleum operations of the Cities Service organization.

Mr. Frame served during World War II as director of refining for the PAW. He assisted in the organization of the PAD, and devoted his full time to the work of the organization during the past year as director of the aviation gasoline program, assistant deputy administrator, and finally associate deputy administrator.

Dr. G. E. Hinds *J. E. Toussaint* *J. B. Hanna* *P. J. Anderson* *H. A. Hemphill* *A. P. Frame*

BOOKS

FIELD GEOLOGY—Frederick H. Lahee	$ 7.50
FUNDAMENTALS OF THE PETROLEUM INDUSTRY—Dorsey Hager	$ 6.00
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GAS ENGINEERS' HANDBOOK—Gas Engrs. Handbook Committee	$12.00
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IGNEOUS AND METAMORPHIC PETROLOGY—Turner and Verhoogen	$ 9.00
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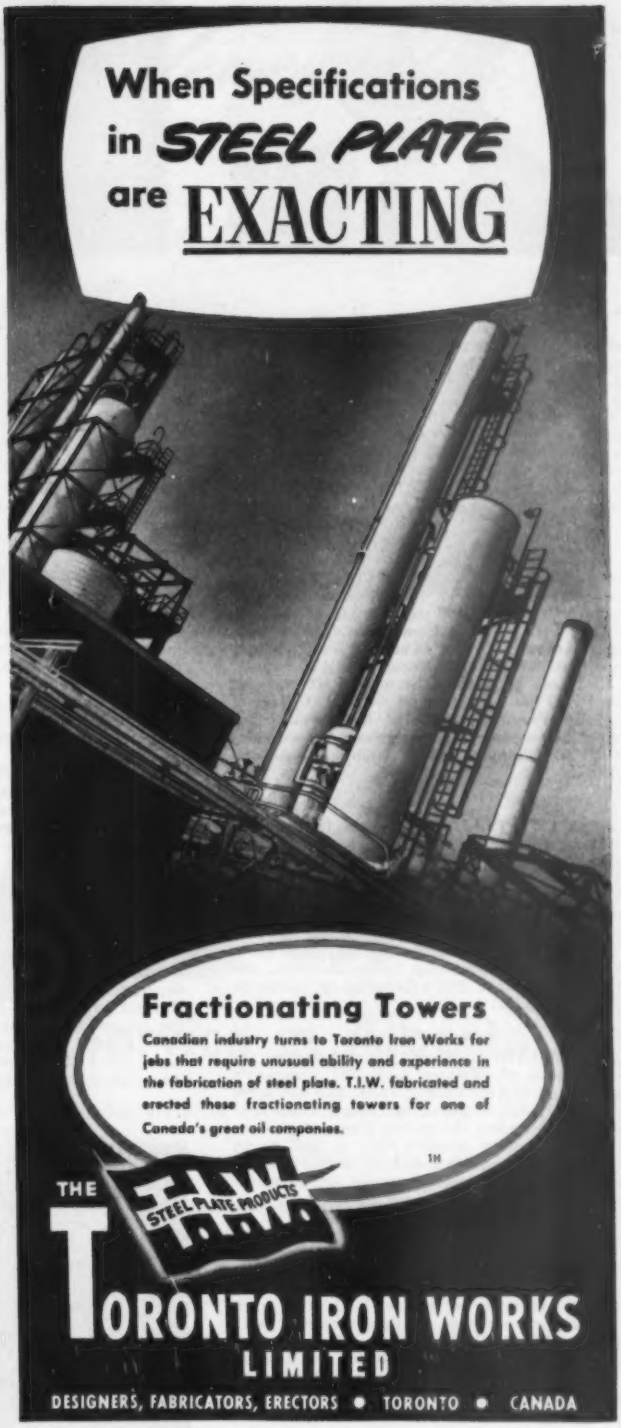
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G. A. Gumbs

J. P. Malott

GEORGE A. GUMBS, JR., who started as an office boy and rose to the position of manager of the traffic division of Esso Shipping Co., has been elected a director. Mr. Gumbs began his career in the foreign shipping department of Standard Oil Co. (N. J.) almost 35 years ago. On the Esso Shipping Co. board Mr. Gumbs succeeds John J. Winterbottom who recently became world-wide transportation coordinator for Jersey Standard. While serving on the board, Mr. Gumbs will continue his duties as manager of the traffic division.

C. MARVIN CASE, who has been serving in the double-barreled capacity of assistant executive secretary of the Foreign Petroleum Supply Committee of PAD and as secretary of the Supply and Distribution Subcommittee of that group, has returned to his post as head of foreign supply coordination for Socony-Vacuum Oil Co., Inc.

His place as assistant executive secretary of the FPSC has been taken by Ralph O. Barr of Standard-Vacuum, and Charles M. Furcht of Jersey Standard has been designated as secretary of FPSC's Supply and Distribution Sub-Committee.

A. B. CHAPPELL, director and treasurer of Seismograph Service Corp., Tulsa, has recently taken leave of absence from his work because of ill health. His active duties will be assumed by F. B. Leedy, assistant treasurer. Mr. Leedy has been with the seismic exploration company since 1934. His experience with SSC includes work in Trinidad, in Argentina as manager and party chief of seismic operations, in the Bahamas, and as vice president of SSC's Canadian operations in British Columbia.

E. A. GALVIN has been appointed general superintendent of Western Gulf Oil Company's Paloma unit in Kern County, Calif., and will serve as general superintendent in charge of the Paloma unit, including the cycling plant and production field. Joining Western Gulf in 1945 as an engineer, Mr. Galvin subsequently served as chief petroleum engineer, chief engineer, and technical advisor before his most recent appointment.

T. L. APJOHN, Socony-Vacuum Oil Co., Inc., has been appointed manager of the wholesale division of the lubricating department. He was formerly supervisor of the products division of the company's research and development department, Paulsboro, N. J. During 1951 he served with the Petroleum Administration for Defense as assistant director of refining and director of the aviation fuels program.

LESLIE H. TRUE, vice president and manager, Magnolia Pipe Line Co., Dallas, has been elected president of the company. Don R. Ford, assistant manager of pipe lines and a member of the board of directors, was elected vice president, and A. T. Glover, general superintendent, was made a member of the board of directors.

J. P. MALOTT, Houston, has been promoted to assistant manager of Continental Oil Company's production department. Mr. Malott, who was formerly southern regional production manager, will make his headquarters in Houston, succeeding H. H. Hinson, recently promoted to general manager of Conoco's new southwestern region, Fort Worth.

Mr. Malott joined Continental 17 years ago and held petroleum engineering positions in several divisions in Texas and New Mexico before coming to Houston three years ago.

DR. VLADIMIR HAENSEL, divisional coordinator of research for the Universal Oil Products Co., received the $1,000 Precision Scientific Co. award in petroleum chemistry at the annual meeting of the American Chemical Society at Milwaukee. Dr. Haensel was cited for his research achievements in the chemistry of petroleum, particularly in the development of the Platforming process.

DELMAR H. LARSEN, formerly with Baroid Sales Division, National Lead Co., has opened offices in Los Angeles as a consulting chemical and petroleum engineer and patent agent. He was with Baroid for 15 years until that firm moved to Texas, and was director of research and more recently manager of the patent department.

JOSEPH D. HARNETT, of St. Louis, has been named assistant manager of the transportation department of the Standard Oil Co. (Ohio). Mr. Harnett joined Sohio in 1941 as an engineer in the transportation department. In 1947, he became general superintendent of pipeline operations, and in 1950 general superintendent of all transportation operations.

WILLIAM C. WHALEY, Los Angeles, Calif., a vice president and director of Sunray Oil Corp., has been transferred to the company's general offices in Tulsa, where he will become a member of Sunray's executive committee and chairman of the company's operating committee. He is succeeded at Los Angeles by R. E. Foss. Paul E. Taliaferro, Sunray director and vice president, will be vice chairman of the operating committee.

Mr. Whaley began his oil experience in 1910, having field, engineering and executive experience with various oil companies in California, Wyoming, Oklahoma, Texas, Montana and Kentucky. He jointed the Barnsdall Oil Co. in 1924 and became general manager of that company's California operations in 1941. He joined Sunray in June, 1950, as a director and vice president when Barnsdall was merged with Sunray.

L. A. SUNKEL has been elected a vice president of the Atlantic Refining Co. and appointed general manager of crude oil production.

Mr. Sunkel makes his home in Dallas, Texas. Since 1919, when he joined Atlantic, he has been in the producing end of the business and located in Atlantic's producing headquarters in Dallas. During these 33 years, he has progressed through the assignments of drilling production clerk, head accountant for producing, assistant general manager, and finally general manager of domestic crude oil production.

W. T. KENNEDY, formerly assistant to the general superintendent of production of Ohio Oil Co. at Findlay, has been appointed assistant division superintendent in the Los Angeles division at Bakersfield, Calif. He is succeeded by R. E. McMillen, Houston division petroleum engineer. L. H. Shearer has been promoted to Houston division petroleum engineer.

DALE NIX and J. C. Stirton have been elected vice presidents of the Arabian American Oil Co. E. G. Voss has been elected treasurer and H. R. Spiegel has been elected assistant treasurer.

Mr. Nix will be in charge of technical and supply services. He has a career of 25 years in the oil industry, and joined Aramco in 1940 as manager of the producing, pipelines and transport department. Last year he was made general manager of oil operations.

Mr. Stirton will be in charge of engineering and construction. He has been associated with the oil industry for 33 years. In 1919 he joined the engineering department of Standard Oil Co. (Ind.), transferring in 1920 to Standard of California. He became chief engineer for Aramco in 1944.

Mr. Voss started his career as an office boy with the Standard Oil Co. of N. J. in 1934. In 1946 he headed that company's investment and finance division, and two years later became assistant treasurer of Aramco.

Mr. Spiegel joined Aramco in 1950 as manager of the foreign exchange division.

D. Nix *J. C. Stirton* *E. G. Voss*

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..for the Oilmen of Venezuela

In their staff quarters and hospital at Maracaibo, Venezuela, employees of the Shell Company are enjoying the supreme comfort of Dunlopillo mattresses and seat cushions.

Shortly after the end of the war the first shipment of Dunlopillo mattresses and seat cushions was delivered to the Shell Company at Maracaibo. So much was their comfort appreciated, so cool and pure did they remain in this extremely hot climate that it was decided to place further orders. Deliveries now total many hundreds of mattresses and cushions.

When hard working men need maximum relaxation, where climatic conditions are extreme, where long-life economy is a vital factor, wise buyers choose Dunlopillo.

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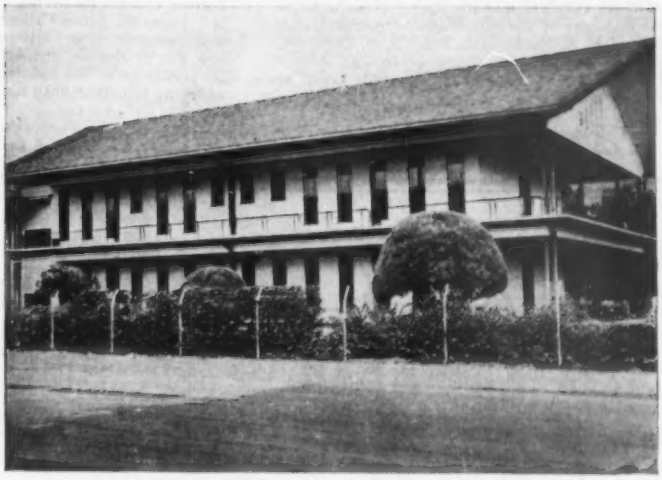

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JAMES E. KEENAN has been appointed assistant supervisor of exploration for the Rocky Mountain division of General Petroleum Corp. at Casper, Wyo. C. E. Carlson succeeds Mr. Keenan as district geologist for Montana, with headquarters in Billings. Mr. Keenan joined General Petroleum in 1946 after four years with the Magnolia Petroleum Co. Mr. Carlson came to General Petroleum in 1949 and has worked in General Petroleum exploration offices in Worland, Wyo., and Great Falls, Mont.

R. E. IRWIN, formerly chief chemist of British American Oil Co.'s manufacturing department, is now manager of the new Montreal petrochemical plant of B. A.-Shawinigan, Ltd. R. O. Campbell, formerly technical assistant in British Americans's marketing department, succeeds Irwin as chief chemist.

EDWARD A. BRADY has been appointed manager of marine sales of Sinclair Refining Co. He joined Sinclair in 1950. He is a graduate of the United States Naval Academy and previously served the Overseas Tankship Corp. as assistant port captain in New York and later was in the foreign sales department of The Texas Co.

DON ANDERSON of Bartlesville, Okla., superintendent of production in the natural gas division of Cities Service Oil Co. (Del.), has been transferred to the company's Calgary, Canada, staff, where he will superintend drilling and production operations in the Canadian plains area. Mr. Anderson joined Cities Service's engineering department in 1930. His experience in gas pipe line, gas production and exploratory work led to his position with the natural gas division in 1945, where he remained until his present promotion.

S. J. Veenstra

SYBRAND J. VEENSTRA has been appointed a vice-president of Asiatic Petroleum Corp. He formerly was manager of the materials department.

Mr. Veenstra joined Maatschappij at The Hague in 1928. From 1930 to 1939 he was assigned to a variety of technical jobs in The Hague and at such oil fields and refineries as Paldjoe, Pangkalan, Brandan and Balikpapan, Netherlands East Indies (now Indonesia), Venezuela and Curacao. During 1933 he spent about eight months on a special assignment in the United States. He left the Netherlands East Indies to join the staff of Asiatic in 1939.

J. NELSON MENDENHALL has been appointed general manager of the domestic crude oil production department of The Atlantic Refining Co. He will be succeeded as manager of the land division by Carle F. Sharp. W. Dow Hamm has been appointed general manager of exploration, which includes both domestic and foreign operations; and Edgar Kraus, chief geologist, is named manager of domestic exploration.

Mr. Mendenhall has been with Atlantic since 1919 as a member of the land division, and was named manager in 1925. Mr. Sharp joined the company in 1926 as an engineer, and was made assistant to the manager of the land division in 1937.

Mr. Hamm became manager of domestic exploration in 1942 and Mr. Kraus, who joined Atlantic in 1921 as a geologist, became chief geologist in 1946.

HOW CAN WE FILL THE OTHER TWO?

Despite the increasing quantity of oil flowing from the wells of Western Canada, Canadians still must import two out of every three barrels they use.

By widespread exploration and the development of new fields, oil companies in the West are striving to build reserves needed to fill the other two barrels.

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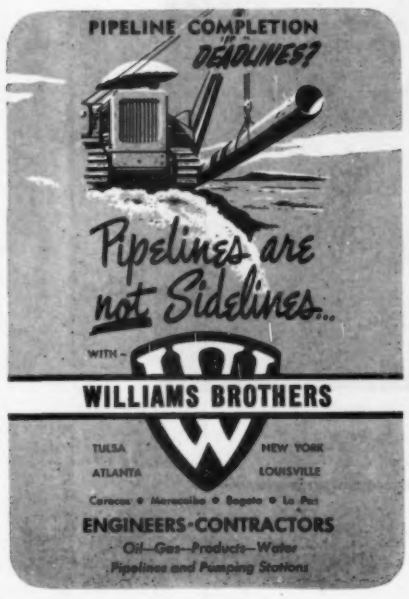
W. A. Gorman

W. A. GORMAN has been appointed vice president and chief geologist of the Rycade Oil Corp. of Houston. Prior to joining Rycade on March 15, Mr. Gorman served as manager of the Houston division of Royal Oil & Gas Corp. for 10 years.

LEO W. STACH of Tokyo, Japan, technical consultant for petroleum and natural gas development in the Far East, is spending a month in Taiwan (Formosa) from April 6 at the invitation of the Chinese Petroleum Corp., and under the auspices of the Mutual Security Agency Mission to China. The purpose of his visit is to evaluate the potentialities for the development of the petroleum and natural gas resources of that island.

LIEUT. COL. HAROLD C. CONNERS, former manager of the Chicago division, Graver Tank & Mfg. Co., Inc., and now director of combat operations of the 315th Air Division, was recently awarded senior paratrooper wings in Japan by the 187th Regimental Combat Team after completing his 30th jump. He is believed to be the first U. S. Air Force officer to have qualified as a senior parachutist.

PAUL D. BALBIN has been named to head Stanolind Oil and Gas Company's geophysical operations in the North Texas-New Mexico division. Mr. Balbin was formerly geophysical supervisor in Stanolind's Tulsa general office.



DR. C. IVAN ALEXANDER has been appointed supervisor of exploration research at Magnolia Petroleum Company's field research laboratories in Dallas. He succeeds Dr. Dayton H. Clewell, who has been named director of the laboratories. T. W. Nelson, former director, has been named associate director of Socony-Vacuum's laboratories with headquarters in New York.

ED B. NICKELSON has been appointed petroleum engineer for Continental Oil Company's central region, with headquarters in Oklahoma City. He succeeds W. E. Landrum, who recently resigned.

Mr. Nickelson until recently was production superintendent for Hudson's Bay Oil & Gas Co., Continental's Canadian affiliate, with offices in Calgary, Alberta. He has been with Continental since 1937.

CHARLES E. CURRY has been promoted to senior superintendent of the newly created Tri-State division of Sohio Pipe Line Co. The Tri-State division is a consolidation of the Mt. Vernon and Grayville divisions. The office will temporarily be at Mt. Vernon, Ill. until a more central location is selected. Mr. Curry was division engineer and superintendent of the southwestern division of the transportation department before becoming superintendent of the Grayville division in 1948.

I. C. (CLEVE) HUFF, JR., has been named assistant to the executive manager of the Independent Petroleum Association of America which he joined as a field representative in 1941. He will help C. E. Buchner, executive manager, with IPAA administrative duties and direct activities of its field staff.

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The facilities of our organization are available to executives of American and Canadian companies engaged in exploration and development of oil and natural gas resources in Western Canada. Inquiries are invited by our Underwriting Department at either our Toronto or Calgary Offices.

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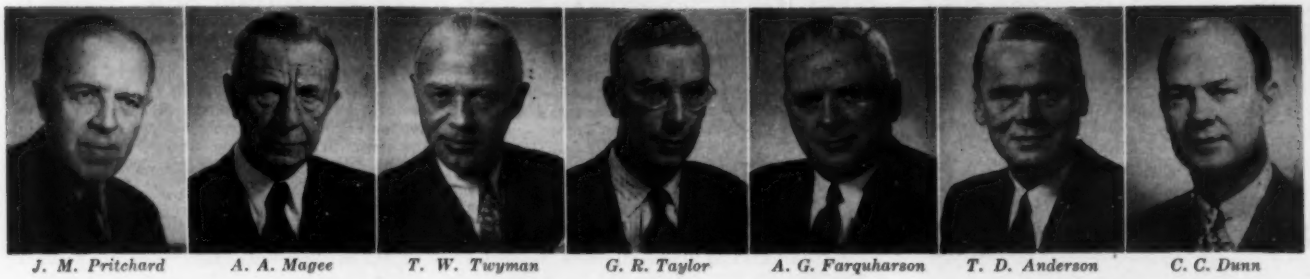

J. M. Pritchard *A. A. Magee* *T. W. Twyman* *G. R. Taylor* *A. G. Farquharson* *T. D. Anderson* *C. C. Dunn*

McColl-Frontenac Promotes Officials

J. M. Pritchard was elected chairman of McColl-Frontenac Oil Co., Ltd. following the company's annual general meeting. He succeeds A. A. Magee who now becomes chairman of the executive committee. T. C. Twyman succeeded Mr. Pritchard as president and chief executive officer of the company. G. R. Taylor was elected executive vice-president to replace Mr. Twyman.

A. G. Farquharson was elected vice president in charge of refining, and T. V. Anderson, former treasurer and comptroller, is now vice president and treasurer.

Mr. Twyman, who formerly served as executive vice president of McColl-Frontenac, started with The Texas Co. in 1930 and joined McColl-Frontenac in 1942. His former chief, Mr. Pritchard, was born in London, Ont., and has a background of many years in Canada's oil industry. He is a director of nine business firms and actively participates in YMCA work, and in hospital and other civic activities.

A. A. Magee is senior member of a Montreal law firm and director of six other Dominion corporations. He also comes from London, Ont. As a general staff officer, he won the Distinguished Service Order for his service in World War I.

Newly elected executive vice president G. R. Taylor had served as a vice president of the company since 1941. He joined McColl-Frontenac as chief chemist in 1930 and was manager of refineries from 1938 to 1941.

A. G. Farquharson, newly elected vice president in charge of refining, studied engineering at Queens University, Kingston, Ont. and joined the refining department of McColl-Frontenac 22 years ago. At the time of his recent election to vice president, he was manager of the refining department, having served in that capacity since 1945.

T. V. Anderson, former treasurer and comptroller who is now vice president and treasurer, is a native of Denmark. He worked for a Far East trading and shipping firm before joining McColl-Frontenac in 1930. He became comptroller in 1939 and treasurer in 1945.

C. C. Dunn was re-elected vice president in charge of sales, a position he assumed last year after many years in various sales capacities with The Texas Co. He served with the United States Navy 1942-45.

Fred Hunt, who was re-elected secretary, came to Canada from England in 1921, after serving with the King's Liverpool Regiment, 1914-1919. Since 1921 he has been continuously employed by McColl-Frontenac and its predecessor companies.

Addresses Canadian LPG Meeting

F. C. Bote of the international division of A. O. Smith Corp., Milwaukee, addressed the March 20 meeting of Eastern Canadian LPGas distributors at Montreal. He outlined the tremendous advances which have been made in the industry in recent years in those parts of the United States which have climatic conditions similar to those in Eastern Canada.

Mr. Bote presented a large number of slides in which he showed the storage and handling equipment used by U. S. dealers in small and moderate size communities. He told of the promotion plans which have been successful and outlined service organization, financing and credit arrangements which have been used. Data was given on commercial and industrial as well as domestic types of installations.

Elected Graver Vice-President

Henry T. Sulcer, general manager of the Graver Water Conditioning Co., New York City, was recently elected a vice-president of the parent Graver Tank & Mfg. Co., Inc. Mr. Sulcer has directed the activities of Graver Water Conditioning since its establishment in separate headquarters in New York.

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FROM

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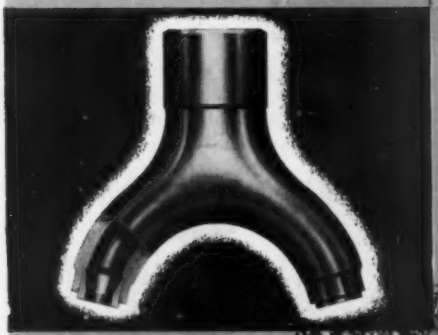
TWIN BLAST

ROCK BIT

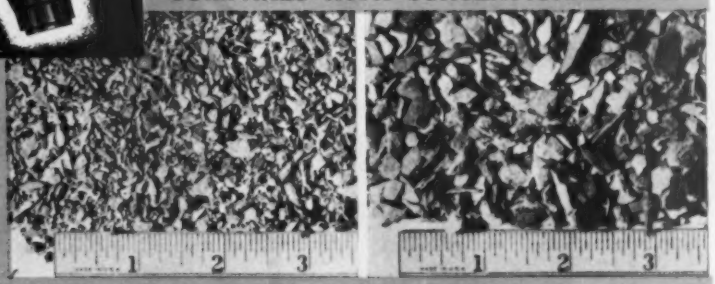


This REED Twin-Blast Slush Nozzle is the heart of this great new series of bits.

For faster drilling and more hole per bit ...use REED TWIN-BLAST ROCK BITS

HERE'S HOW IT WORKS: High velocity slush from the nozzles of the new **REED** Twin-Blast Rock Bit hits the bottom of the hole first—blasting the cuttings from the bottom of the hole as quickly as they are chipped loose to let the cutter teeth take a full "bite" on the formation.

THESE CUTTINGS SHOW HOW IT COMPARES WITH CONVENTIONAL BITS



CONVENTIONAL BIT **TWIN-BLAST BIT**

Both sets of these cuttings were taken in the same formation, under similar conditions. Those taken with a conventional bit are small, indicating that re-cutting had taken place. Cuttings made with the Twin-Blast Bit were blasted up into the mud stream before re-cutting could take place. The Twin-Blast Bit drilled faster and gave more hole in this formation.

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Chalmette Refinery . . .

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Completed within nine months, this 5600 b/d UOP Fluid Catalytic Cracking Unit was built by Procon for The Bay Petroleum Corporation, Chalmette (La.) refinery with less than 30 days' interruption in plant operations. Shut-down time was minimized by fast work in converting existing equipment to use with the new cracker.

While this new unit was still under construction, Bay Petroleum placed an order with Procon for a second UOP fluid cat cracker to be built at their Denver refinery. Such confidence is convincing evidence of Procon's ability and facilities to handle any refinery or petro-chemical plant construction job.

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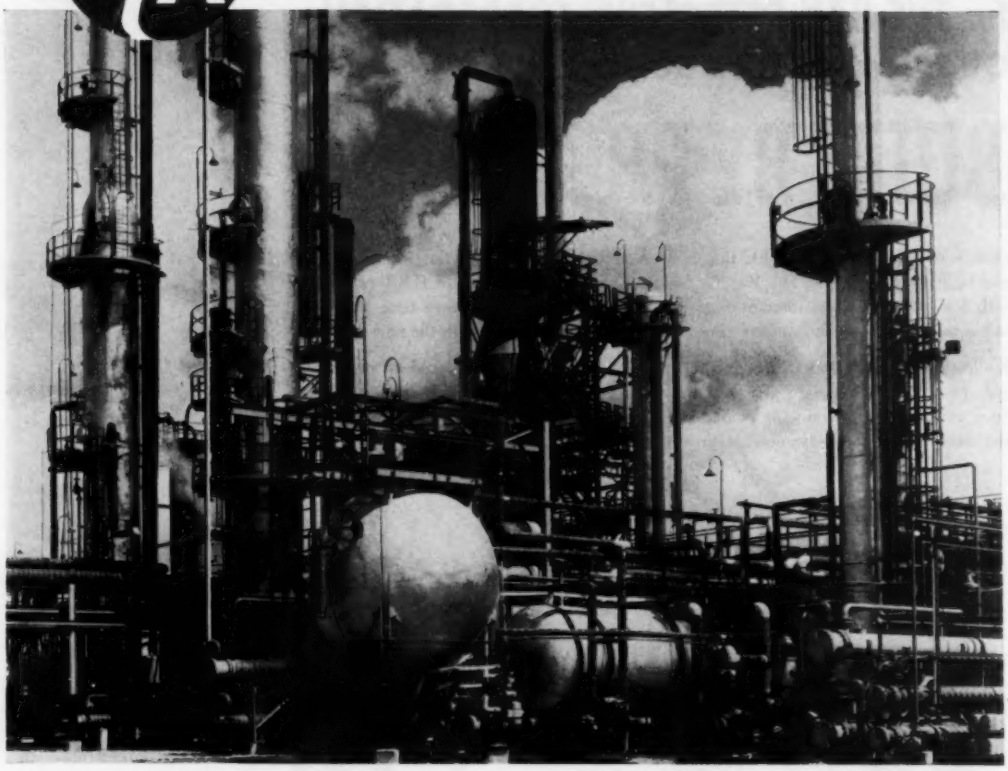
another leading refiner who desalts with PETRECO



At Edmonton, Alberta, The British American Oil Company Limited has recently put into service a complete new refinery. Intended to handle production from Canada's great western oil fields, this new British American installation incorporates the most modern developments in refining technology. Like other leading refiners everywhere, British American at Edmonton relies on Petreco for desalting.

The Petreco desalter illustrated above desalts 5200 barrels per day of Redwater crude, with salt removals ranging from 94% to 96%. The electrosphere is one of Petreco's new high-efficiency, high-throughput spheres, eleven feet in diameter.

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The New Brantly Handbook

Rotary Drilling Handbook, fifth edition, by J. E. Brantly; published 1952 by Palmer Publications, New York; 702 pages, $10.00.

It is a little more than 20 years since the rotary drill definitely established itself as the most efficient and speedy method of drilling oil wells, and 16 years since the first edition of Brantly's Handbook of Rotary Drilling came off the press and promptly became indispensable as the rotary driller's manual of instruction and advice. How well it served its purpose is evidenced by the fact that new editions have had to be issued every four or five years. With every new edition it increased in size; the present fifth edition contains 702 pages, 134 more than the edition of 1948.

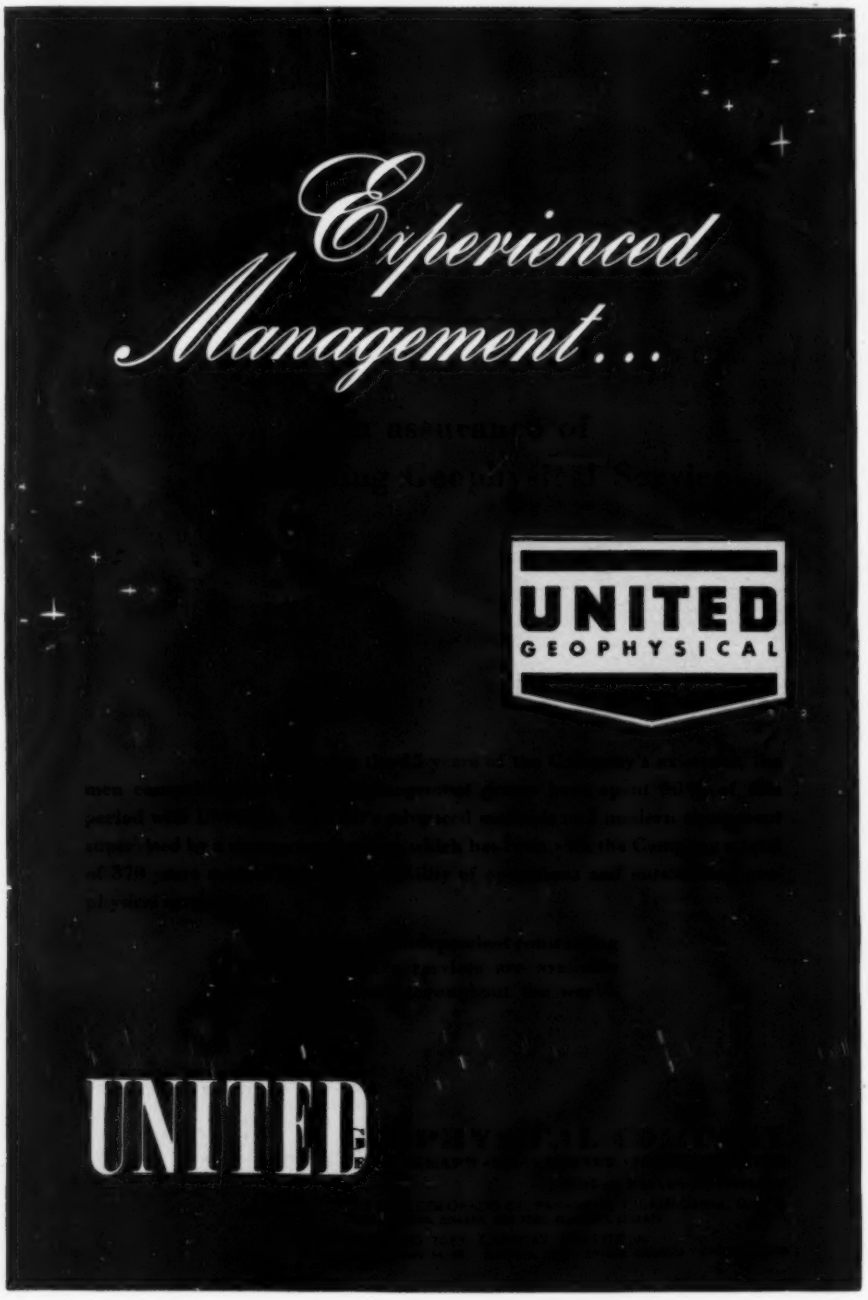
The drilling of oil wells is one of the most complicated, expansive and expensive (and also risky) operations in all modern big industry. Every oil field, and generally every sizable portion of every oil field, is a case in itself, presenting geological and physical aspects that represent a great range of conditions to which the driller must conform his practice and to which his equipment must be adapted. The inevitable variations in practice and tools in the thousands of the world's oil fields can be understood only by the well informed. The author states frankly that it would be impractical and undesirable to cover all these variations in one handbook, so he takes it as his purpose to cover the high points and most important phases of well drilling equipment and drilling methods that will serve all normal needs, leaving the rarer, specialized problems to the many fine monographs and articles published in the proceedings of the American Petroleum Institute, the American Society of Mining and Metallurgical Engineers, the American Association of Oilfield Drilling Contractors, etc. His Handbook is thus intended for those who do the actual mechanical operations of drilling, including engineers, helpers, drillers, tool pushers and superintendents, who all must be highly skilled in the boring of holes in the ground, as well as for the executive and student interested in modern theory and technique. These operators must be fully informed on the elements of a complete rotary drilling rig—steam boilers, steam engines, internal combustion engines, electric power, power transmission, drawworks, derricks, hoists, cables, rotary tables, drill pipe, casing, tool joints, bits, mud pumps, drilling fluids, and all the numerous other appurtenances that constitute a complete, "well balanced" rotary drilling outfit. Further, they must be able to adapt drilling tools to the peculiarities of geological formations and the physical forces that arise out of these peculiarities, and to meet the situations and accidents that are part of all driller's lives.

What Mr. Brantly has done is to put at the disposition of members of rotary drilling crews all of that material and all the tables that are daily required by the field engineers or practical rig operators, with particular concern for engineers and drillers on foreign operations, remote from other sources of information and advice.

With the passing of years these essentials have become more exacting and numerous as research has shown more and better ways of putting oil wells down. In the beginning, when rotary drilling was new and relatively simple, the task of keeping Brantly's Handbook up to date was a one man job. From the third edition specialists were called in to give the more complex subjects authoritative treatment. In this fifth and latest edition, Mr. Brantly has had the assistance of Earl S. Knox on the subject of electric power plants; John P. Selberg (International Derrick and Equipment Co.), Robert W. Craig (National Supply Co.), and D. A. Powell (Drilling and Exploration Co.), collaborators on derricks; and of Floyd L. Scott, L. E. Garfield and M. L. Talbert (Hughes Tool Co.), and Wiley B. Noble (Reed Roller Bit Co.), collaborators on bits. In the chapter on drilling shafts, he had the assistance of Floyd L. Scott, H. G. Texter, John D. Spalding, R. S. Grant and S. C. Moore. The last three named have contributed abundantly of their knowledge of the causes and the prevention of drill and tool joint troubles, the source of most of the annoyances that are encountered in rotary drilling. The chapter on drilling fluids was written by E. W. Louden (Baroid Sales Division of National Lead Co.). As befits its critical importance, this subject occupies more space—61 pages—than any other chapter in the book. The chapter on directional drilling was written by Don K. Weaver, now deceased. Elmer L. Decker (Martin-Decker Co.) contributed the material on above-ground instruments. The major portion of the chapter on fishing and fishing tools was prepared by D. Siracusa. The chapter on formation tests reflects the experience of engineers of the M. O. Johnston Oilfield Service Co. The chapter on safety measures was prepared by Doyle Settle, secretary of the American Association of Oilfield Drilling Contractors.

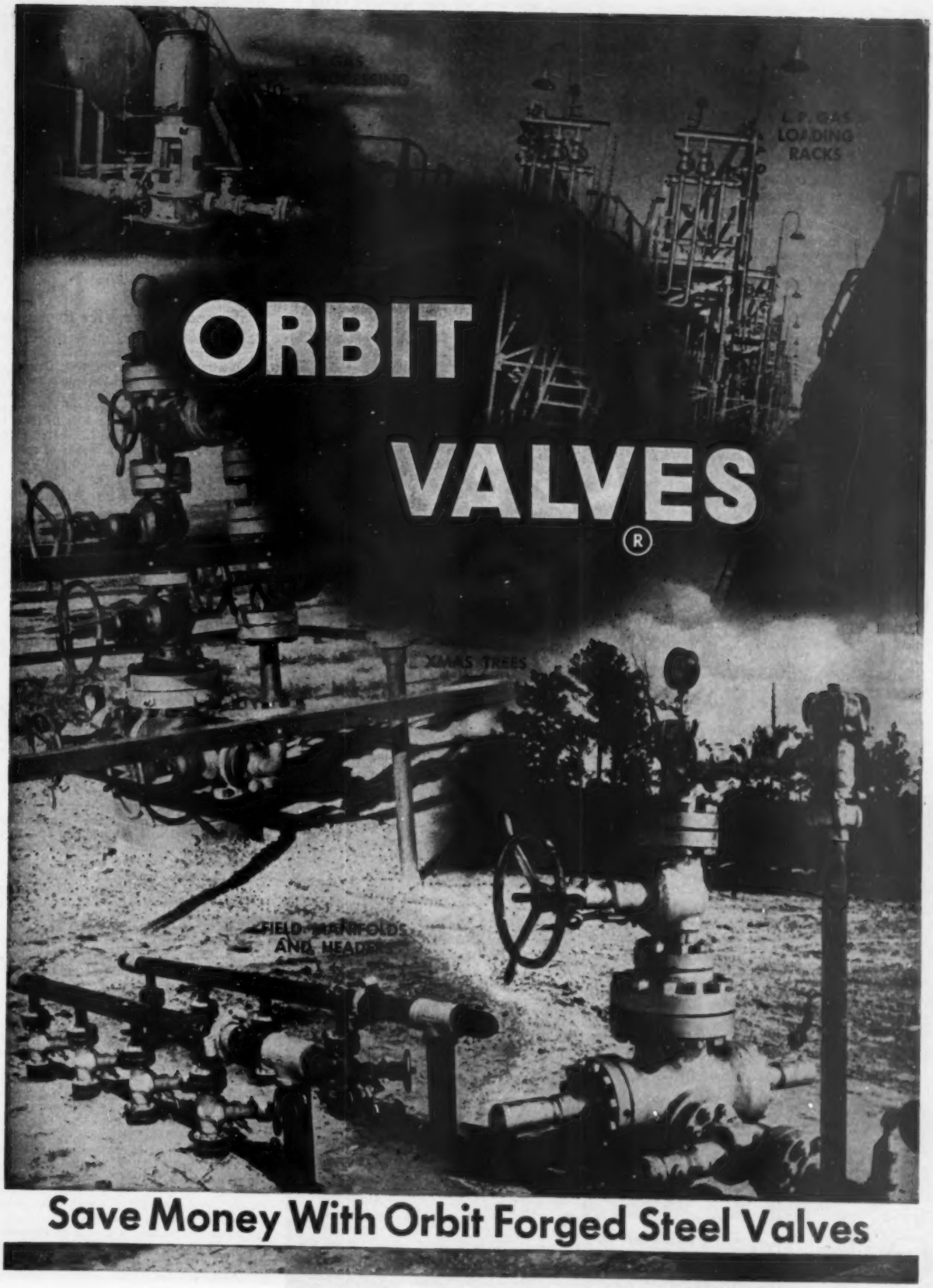
Besides all this, Mr. Brantly's new Handbook embodies the experience of other authorities on various phases of oil well drilling. With this assistance, he has evidently succeeded in his purpose of making a handbook that covers all the normal problems and exigencies which confront operators of rotary drilling rigs.

Mr. Brantly concludes his text with a summary containing specifications of a complete and "balanced" string of heavy duty steam rotary drilling tools based on a power plant supplying steam at 350 pounds, which is regarded as high pressure in oilfield work. Two power rigs and a diesel-electric rig are similarly outlined. In the back of the book are 220 pages of tables and data that will enable the petroleum engineer to dimension his layout in the field.



Wyoming-Utah Products Line

Pioneer Pipe Line Co. has been organized by Continental Oil Co. and Sinclair Oil Corp. to build a 12,000-barrel 8-inch products line from Sinclair, Wyo., to Salt Lake City. The 310-mile line will cost about $8 million. A $1 million terminal will be built at Salt Lake City and connection made with Salt Lake Pipe Company's line to a point on the Columbia river in Washington. Continental owns 65 per cent of the new line and Sinclair 35 per cent.



Save Money With Orbit Forged Steel Valves

Pure Builds Orthoflow Crackers

As part of an overall modernization program at Pure Oil's Toledo (Ohio) and Smith's Bluff (Texas) refineries, The M. W. Kellogg Co. will design and erect two of the largest Orthoflow Fluid catalytic crackers ever built. The one at Smith's Bluff is currently being engineered for a capacity of over 26,000 barrels per day, more than twice as large as any of this new design to date. Throughput of Toledo's new unit will be about 17,000 b/d.

At Toledo, new equipment will include a light ends recovery system, a catalytic polymerization unit and sulfur removal equipment. Major revamp will be the alteration of existing equipment into a vacuum feed preparation unit at Smith's Bluff. Kellogg's contract includes a new 20,000-barrel vacuum feed preparation unit, a cat poly unit similar to Toledo's, light ends recovery, sulfur removal equipment, and revamping of thermal cracking facilities. Construction on both jobs is underway.

Heads Davison Production

Finley C. Nicholson has been appointed to the newly-created post of manager of operations of Davison Chemical Corp. He will be in charge of all production except mixed fertilizer. Mr. Nicholson has been with Davison since 1942, most recently as manager of the Cincinnati catalyst plant. He is succeeded in the latter position by J. W. Long, formerly superintendent of silica gel operations, stationed at Davison's Baltimore plant.

Brig. Gen. David N. Hauseman, Ret., has been appointed a marketing executive of the corporation. He resigned as president of Houdry Process Corp. of Philadelphia to join Davison's executive force.

Emory M. Skinner

Emory M. Skinner, 48, chief engineer and technical director of Socony-Vacuum Oil Co. Inc.'s Augusta, Kans., refinery, died February 29. He had been with the firm 17 years.

W. M. Broxham

Named Graver Vice President

E. N. Gosselin, president of Graver Tank & Mfg. Co., Inc., East Chicago, Indiana, announces that at a recent directors meeting, Graver's manager of sales, Willard M. Broxham, was named vice-president in charge of sales. Mr. Broxham has spent more than 30 years with Graver, almost entirely in the sales department. In 1946, he was made sales manager for the fabricated plate division. In 1950 he became manager of sales for all divisions.

New Diesel Fuel Additive

Samples of a new ignition improver for diesel fuel are being made available by Ethyl Corp. for evaluation by the oil industry, it is announced by B. Bynum Turner, vice president in charge of research and engineering. The compound consists of a mixture of primary amyl nitrates which is blended into the finished fuel. As little as one-tenth of one percent by volume of Ethyl's ignition improver is sufficient to bring many distillate heating oils within the cetane number range of commercial diesel fuels. It is effective regardless of crude source, refining technique, or sulfur content.

The performance tests being undertaken by the oil industry follow extensive investigations already in progress. These include large-scale service tests by the U. S. Navy, over-the-road tests in diesel trucks, and full-scale tests in the Ethyl Research Laboratories in Detroit.

Only small amounts of Ethyl's ignition improver, tests have shown, are necessary to bring many distillates within the desired cetane range. On the average, five cetane numbers may be gained in a fuel with the addition of 0.13 volume percent of the ignition improver. A gain of 2½ cetane numbers, on the average, is obtainable with 0.05 volume percent.

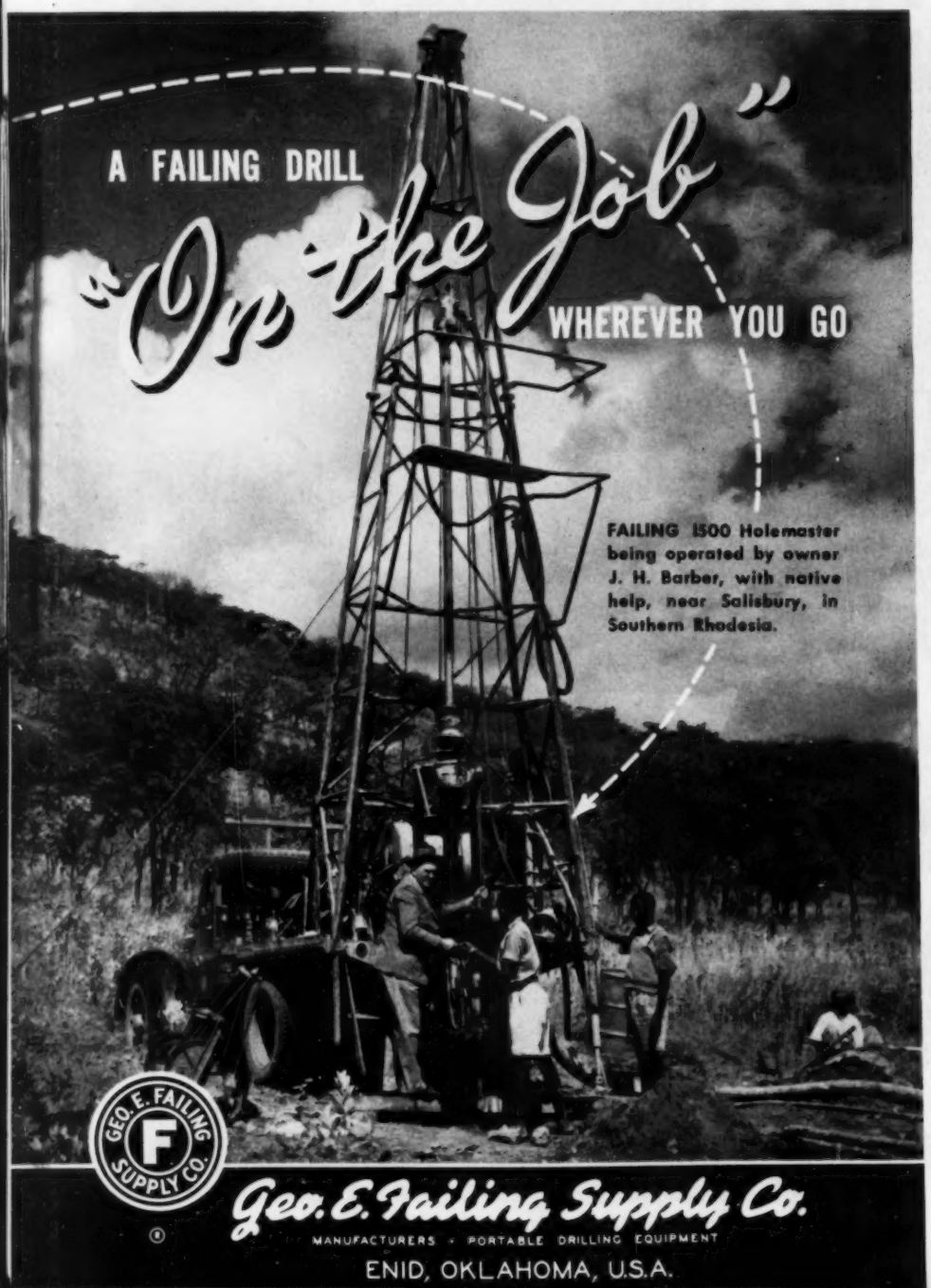
Laboratory tests indicate, Mr. Turner said, that cetane numbers gained with Ethyl's ignition improver are the equivalent of natural cetane numbers, and this added ignition quality is retained during storage.

Commercial production of Ethyl's ignition improver awaits the outcome of the extensive service tests now underway.

Book Review

The Financial Post Survey of Oils; 1952, Canada Edition; published by Maclean-Hunter Publishing Co., Toronto; 300 pages, $2.00.

This publication is intended for investors in the oil industry of Canada, which is showing a continuing trend of higher production backed by still greater reserves. Expansion of the industry in the west will be assured by the new Trans-Mountain pipe line to the west coast. This survey reviews 600 active western oil companies, which has required extensive revision and enlargement of the map section. Besides individual write-ups of the western oil companies, the volume includes a five-year price range of oil stock movements and a wealth of statistical material. A section listing inactive and defunct companies brings to 2,500 the total number of companies covered.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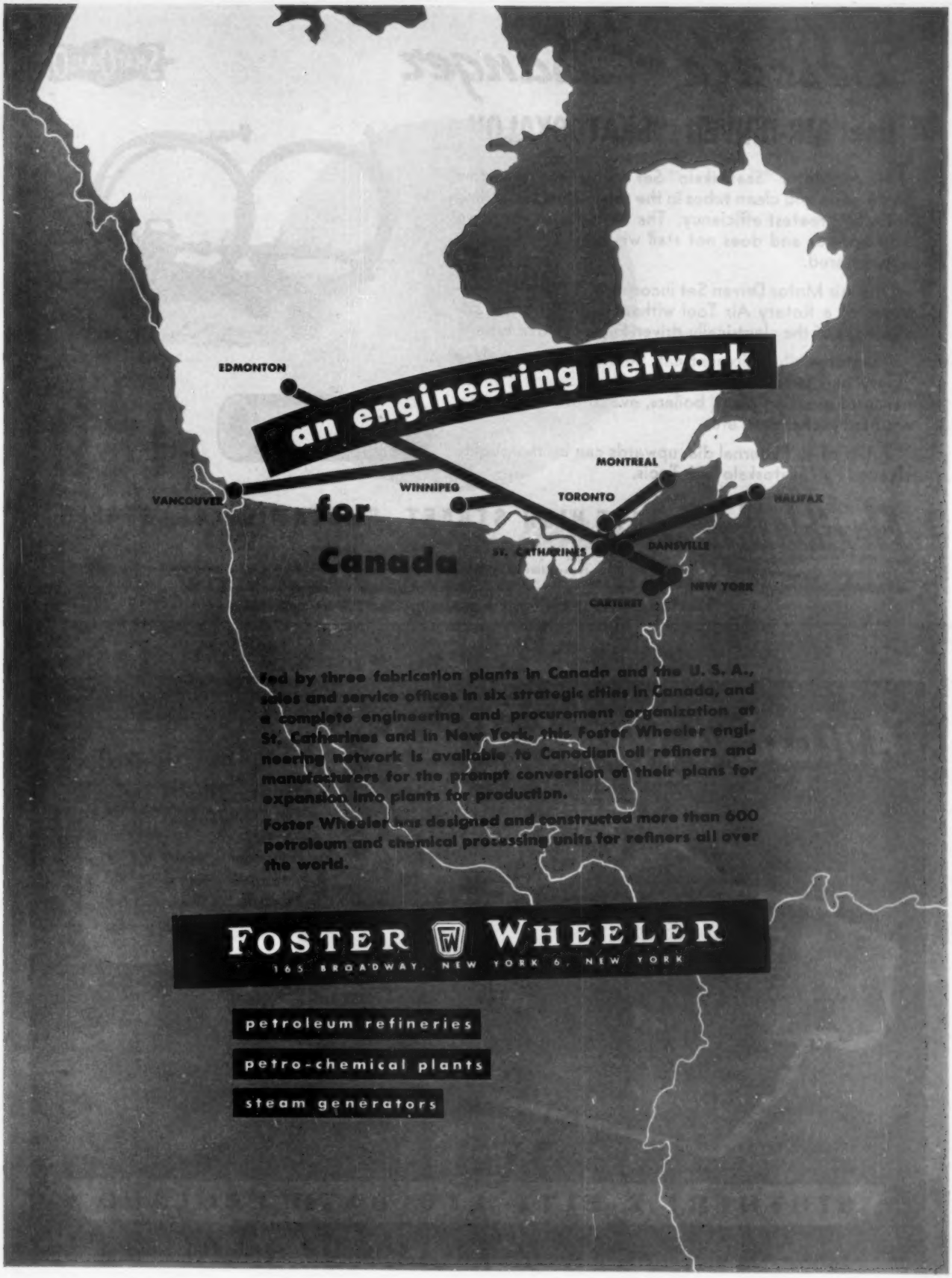
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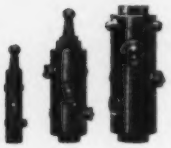

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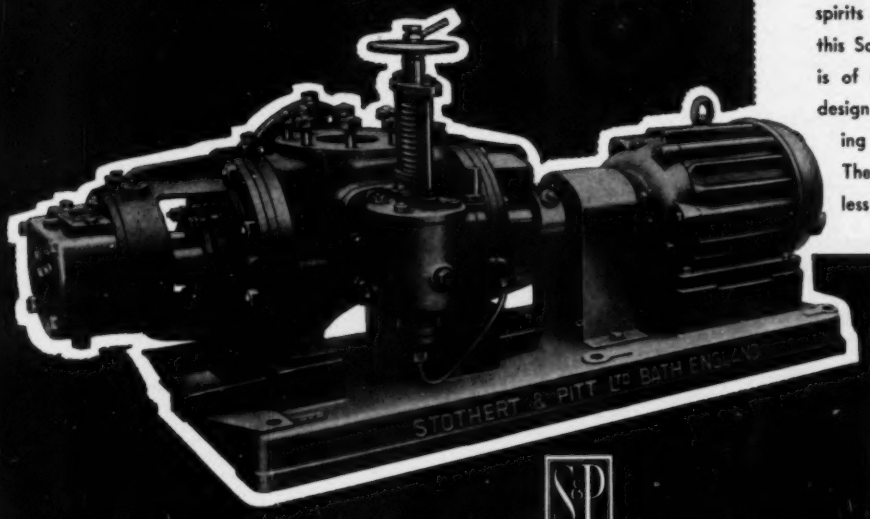

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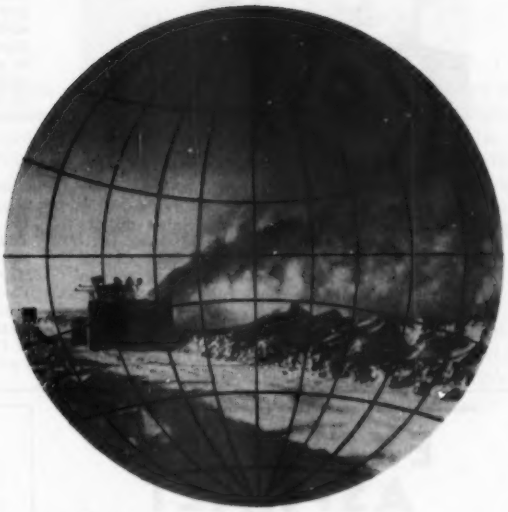

the Canadian approach...

to the exploitation of its vast petroleum resources follows a familiar path in the history of other great proven regions. The search is keyed to geophysical activity, with approximately 22 percent of the world's crews operating in the Canadian provinces. In recognition of this tremendous growth an important step has been taken to coordinate activities under an increasing demand for GSI services in the Dominion of Canada. We proudly announce the formation of Geophysical Service International Corporation with C. M. Moore, Jr., as Vice President and Manager. Canadian operators will continue to receive the services of experienced resident personnel plus the benefits of GSI's complete research and development programs. Mr. Moore and his supervisory staff have made major contributions to the seismic techniques of this vast region. They are an important part of Canada's geophysical history. Their knowledge can be yours.

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VICE PRESIDENT and MANAGER

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Rockwell District Sales Managers

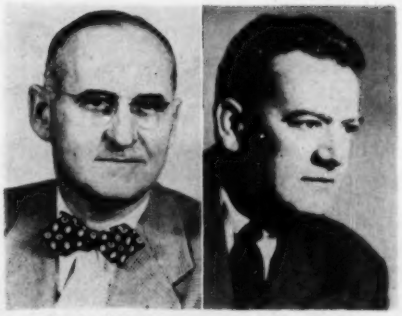
M. D. Gilbert has been appointed Kansas City district sales manager and Roy R. Bush Tulsa district sales manager. Mr. Gilbert joined the predecessor Pittsburgh Meter Co. in 1924. In 1944 he was promoted to Tulsa district sales manager.

Mr. Bush has had 20 years of operational and sales experience in the drilling, production, pipe line, and refining phases of the petroleum and gas industry. He was first affiliated with various drilling contractors and later the Texas Pipeline Co. He joined Rockwell in 1934.

New Office Building

L. E. Heinen, president of Tube-Kote, Inc., has announced the completion of the company's new $50,000 office building on the grounds of the plant's 15-acre tract at 2520 Holmes Road, Houston.

Tube-Kote pioneered the development of thermo-setting plastic coating for oil-field pipe and tubing used in the oil and chemical industries. Last year the company brought out a new rubber-type copolymer baked-on plastic coating to supplement its earlier product.



M. D. Gilbert *R. R. Bush*

BEN F. STIBA has been appointed district sales representative for the Baroid Sales Division, National Lead Co., in the Corpus Christi district. He has been a field service engineer in the Gulf Coast division since 1948.

HENRY W. PATTISON has been elected a director and vice president of Sohio Pipe Line Co. and Harry S. May a director.

Floating Roof Tank Booklet

Graver Tank and Manufacturing Co., East Chicago, Ind., has published a new booklet entitled "Double Deck Floating Roof Tanks." Applications for sour crude and volatile products storage are discussed and operating features are described. Special mention is made of the seal and seal mechanism, and the non-tilting and non-sinking features of the design. Loss factors for standing storage of volatile products are shown in chart form for easy calculation. The booklet closes with construction specifications and data on standard and special accessories. Copies are available on request.

Moves To Fort Worth

Southwestern Consultants, Inc., a contract seismograph firm with six crews and more than 100 employees, has moved its central office from Tulsa to Fort Worth, Dr. Sidon Harris, recently named president of the company, announced. Dr. Harris also heads Southern Geophysical Co. of Fort Worth. G. C. Shivers, Jr. is executive vice president of Southwestern Consultants and is stationed in the Rocky Mountain Division offices in Denver. R. E. Gathings is vice president and Carl Hoera, secretary treasurer.

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Here you'll find discussions not only of general lubrication requirements, but *entire chapters* devoted to such important topics as the lubrication process, flow characteristics, sludge and lacquer deposition, emulsification and foaming, with ample reference to viscosity, pour point and extreme pressure lubrication. Worthy of special mention is the special chapter designed to point out the effects of *each step* in the manufacturing process upon the performance characteristics of the final product.

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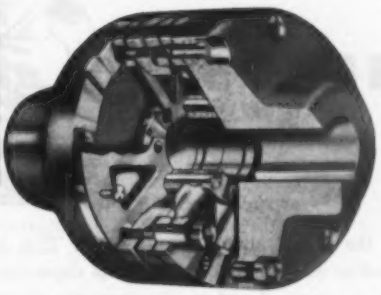

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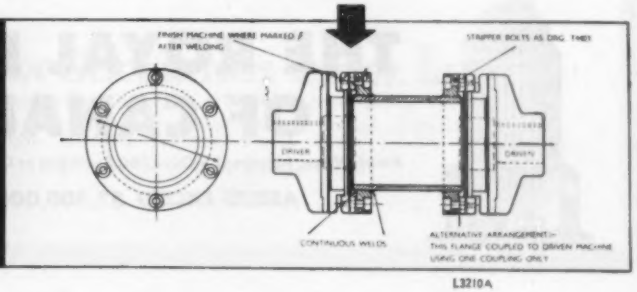
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W. K. Warren

First U. S. Orthoflow Plant Completed

The first Orthoflow catalytic cracking unit in the United States is now in operation at Cities Service Oil Co.'s Ponca City, Okla., refinery. The 8,350-barrel cracker is part of an expansion and modernization program started last February which will increase the plant's capacity to 20,000 barrels of crude per day. It was designed and installed by the M. W. Kellogg Co.

W. K. WARREN, president of Warren Petroleum Corp., was honored at a banquet in Tulsa recently on the occasion of the 30th anniversary of the founding of the company he heads. More than 500 friends attended the banquet and participated in presenting to him an antique tray.

Mr. Warren organized a brokerage concern in 1922 with a capital of $3,000. The company in 30 years has grown to a $100 million corporation engaged in producing crude oil and natural gasoline and in manufacturing and marketing LPGas.

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In Alberta, Canada's oil-rich province, Royal Bank branches number 57, including Calgary, Edmonton, Leduc, Devon, Redwater, Turner Valley. In Saskatchewan, Manitoba, and British Columbia, where interesting oil developments are taking place, branches total 199. We do not provide information on oil securities.

Address your enquiries to J. C. Mayne, Supervisor, The Royal Bank of Canada, Calgary, Alta.

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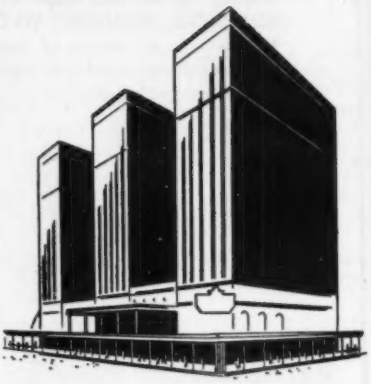

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GENERAL PETROLEUMS OF CANADA LIMITED

Oil Well Drilling Contractors

509 Eighth Ave. W.

Calgary, Alberta

NEW SUPERIOR OILS OF CANADA LIMITED

509 8th Avenue W.

Calgary, Alberta

WE ARE PROUD OF OUR

32 YEARS SERVICE

TO THE CANADIAN OIL REFINING INDUSTRY . . .

In the early days of this vast Canadian industry, NATIONAL AIROIL supplied oil burners for simple crude and high pressure shell stills. Later, we furnished combination gas and oil burners for pipe stills and cracking coils. Today, NATIONAL AIROIL oil-gas Tandem Combustion Units for vertical or horizontal firing are widely specified and used for the big, modern crude heaters.

Also, we provide air heaters and regenerator quenching devices for the Fluid Catalyst Cracking Units . . . and our combustion equipment is extensively used in boilers, and now, in large steam generators for Canadian Refineries.

NATIONAL AIROIL BURNER COMPANY, INC.

1264 East Sedgley Ave., Philadelphia 34, Pa.
Southwestern Division: 2512 So. Blvd., Houston 6, Tex.

Film Wins Award

"Man On The Land," the Oil Industry Information Committee's 1951 motion picture, has been awarded an honor medal by Freedoms Foundation, Inc., for making an outstanding contribution to the principles of freedom. This is the second year in a row that the Oil Industry Information Committee's motion pictures have been cited by the Foundation.

HARRY P. BROOM has been appointed vice-president of Ralph M. Parsons Co., Los Angeles. He will be in charge of the New York offices at 10 East 40th Street.

For the past 12 years Mr. Broom has been with E. B. Badger & Sons Co. and its successor, Stone & Webster Engineering Corp. Before that he was director of the development laboratory of Houdry Process Corp., on assignment from the Sun Oil Co.

H. P. Broom

OIL

in the *New Economy*

New oil discoveries and increased production of Canadian crude oil are having a marked effect on the economic development of our country. The future of the Canadian petroleum industry should be of great interest to investors and financial institutions.

We have been associated with the underwriting of the securities of Canada's leading oil producers and refiners and will be pleased to discuss with officers of oil companies the ways and means of providing additional funds for development or working capital.

We have in our offices up-to-date information on all phases of the oil and allied industries, which is available without cost or obligation.

DOMINION SECURITIES CORPN. LIMITED

Underwriters and Distributors of Investment Securities since 1901

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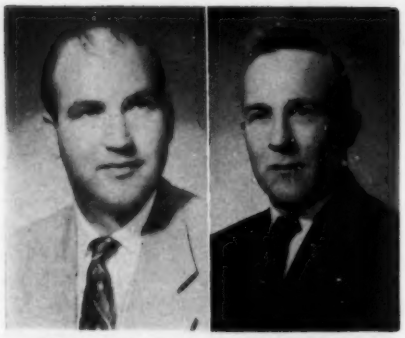


D. T. Fowler *J. M. Bugbee, Jr.*

Harry T. Vogel

Harry T. Vogel, 61, division manager of Signal Oil & Gas Co., died March 1 at Fort Worth, Tex.

Fowler Heads Baroid Advertising

Donald T. Fowler has been named advertising manager of Baroid Sales Division, National Lead Co., Houston. Experienced in the oil industry since 1940, Mr. Fowler has been associated with the Axelson Mfg. Co., Byron Jackson Co., and was with the advertising department of Lane-Wells Co. for several years before joining Baroid. His background includes both engineering and advertising work. During the war, he was employed at North American Aviation, Inc., and later served in the Navy.

James M. Bugbee, Jr., because of his field service experience, has been transferred to the advertising department to assist in the preparation of technical publications relating to oil well drilling muds, well logging, and testing equipment. His previous experience with Baroid includes well logging work in the southern half of the United States and mud engineering service in North Central Texas oil fields.

Penola Reorganization

In a reorganization of Penola Oil Co., marketing affiliate of Esso Standard Oil Co., S. P. Gildersleeve has been named general manager. M. deLuna, formerly in charge of export sales, becomes assistant to President Clarence M. Davison. W. P. Hamilton is now manager of the newly-formed wholesale department in both the export and domestic markets.

J. J. Walsh now heads the wholesale department, lubricating oil, and R. A. Millard has been appointed manager of the Essomarine sales. C. P. Hannenman will continue as manager of direct marketing. G. E. Evans becomes technical coordinator.

Joins Byron Jackson

Jack Smith, formerly with International Cementers, Inc., is now representing Byron Jackson Co. in foreign countries for oil tools and associated drilling and production equipment.

Oil and Buying Power

"As a market for the United States, Mexico is first among the Latin-American nations and third in the world."

Foreign Commerce Weekly, Dec. 31, 1951

Mexico's emergence as a nation of great purchasing power is based on the development of a diversified economy.

Industry, agriculture and transportation are growing together . . . stimulated by public works and other governmental programs that offer expanding horizons for development of the nation's potentials.

Serving all these is oil . . . fuel for the farmer's tractor, the industrial machine, the locomotive, the highway carrier . . . for the automobiles of Mexicans and visitors . . . for domestic and international airlines . . . asphalt for road building . . . natural gas and heating oil for industrial and domestic use . . . sulphur for the chemical industry.

Mexico's oil industry serves these and many more uses with *products made available at low prices where needed* . . . with a refinery output that has more than trebled since 1937 . . . and provides a surplus to help other nations meet their oil requirements.

Oil is at work. The results are evident.

PETROLEOS MEXICANOS

MEXICAN PETROLEUM ADMINISTRATION

CROSSLEY-PREMIER

SLOW SPEED OIL ENGINES FOR POWER GENERATION

CROSSLEY-PREMIER ENGINES LTD., SANDIACRE, Nr. NOTTINGHAM.

London Office: Langham House, 308 Regent St., W.1.

This unusual photograph of storage tanks typifies the qualities of "International" paints; the products for the petroleum industry are unusually good. But this standard did not just happen; it was reached after pursuing a policy of producing the right paint for the purpose. For instance, among other products used throughout the industry "International" makes special paints for the protection and decoration of drums.

USE "INTERNATIONAL" DRUM PAINTS and other products for the Oil Industry.

A Shell photograph

THERE'S MORE IN THIS THAN MEETS THE EYE

A WORLD-WIDE PAINT ORGANISATION

Registered Trade Mark

International Paints Ltd

GROSVENOR GARDENS HOUSE, GROSVENOR GARDENS, LONDON, S.W.1. Tel.: VICtoria 3161 (10 lines)

ASSOCIATED COMPANIES AND AGENTS THROUGHOUT THE WORLD

Mexican Equipment Branches Planned

The Weatherford Tool Co. will establish a branch in Tampico, Mexico, a spokesman for the Mexican Chamber of Commerce of New York announced in Mexico City. A site for the factory is reported to have been selected in the La Isleta section of Tamaulipas State, with details in charge of Jesse H. Hall, Weatherford president. The same spokesman said Dresser Industries is also considering founding a Mexican branch to produce equipment for Pemex.

CHARLES R. ELDER, of St. Louis, has been promoted to superintendent of the southwestern division of the transportation department of Sohio Petroleum Co. He has been conducting southwestern operations since 1950 as assistant superintendent and will continue to make St. Louis his headquarters.

G. W. HULDRUM, JR. has been appointed sales manager of the western division of Shell Chemical Corp. Mr. Huldrum joined Shell in 1939, and in 1947 was appointed district manager of the Detroit sales office. Two years later he returned to San Francisco as manager of agricultural products, western division, and in 1951 became assistant sales manager, western division.

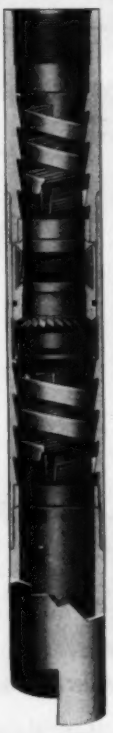
FHP Gear-Motor Booklet

A new eight-page, two-color bulletin, GEA-5678, on fractional-horsepower gear-motors listing 61 standard models from which to choose has been announced as available from the General Electric Co., Schenectady 5, N. Y.

The publication describes the applications for FHp gear-motors and outlines a simple method of determining correct horsepower requirements with the use of an ordinary pipe wrench and fish scale.

"Grapple Grip"

The spiral grapple moves down over the fish easily as the string is rotated slowly to the right.
Twist to the right is then allowed to slack off, and thereafter when upward pull is exerted the grapple is contracted and the hold is secure. (Note that the grapple has a hold AS SOON AS IT IS OVER THE FISH!)



Holds Tighter as Load Increases!

In today's fishing jobs, you can't take chances on weak-kneed tools. It is imperative that you get the pipe out of the hole quickly and safely without further equipment losses!

And when you have a job for an overshot, there's one way to make sure that you get a rock-solid grip every time—a grip that cinches tighter as pull increases. ORDER OUT A BOWEN RELEASING OVERSHOT!

NO SLIPS TO CHANGE . . . NO ADJUSTMENTS

Without changing slips or making any adjustment whatever, this tool catches drill pipe, coupling, or tool joint—whichever is up! As soon as it's over the fish, the spiral grapple takes hold with a full-length crush-proof grip that tightens as pull increases.

An integral milling member rounds up any ragged ends of the fish, and a guide on bottom gets the tool over the fish. Although made with minimum outside diameter for use under tight hole conditions, the Bowen Overshot nevertheless withstands the hardest pulling or jarring operation. And release from the fish, if necessary, is a simple matter of a downward bump, a turn to the right and simultaneous upward movement. It both sets and releases—TO THE RIGHT!

One to as many as four-bowl Overshots can be supplied in the size you need for any job.

Write for descriptive literature!

SR BOWEN CO

MAIN OFFICE AND PLANT:
11008 SOUTH NORWALK BOULEVARD
SANTA FE SPRINGS, CALIFORNIA
EXPORT OFFICE:
30 ROCKEFELLER PLAZA
NEW YORK CITY, NEW YORK
EXPORT REPRESENTATIVE: VAL. R. WITTICH, JR.

W. A. Wilson

Wilson Heads Los Angeles Nomads

W. A. Wilson of Web Wilson Oil Tools, Inc. has been elected president of the Los Angeles chapter of Nomads for 1952 to succeed Earl Rees of the Byron Jackson interests who has been transferred to New York as export manager. C. C. Sutton of Oil Well Mfg. Co. was inducted as an associate member at the March meeting. Announcement was also made of the appointment of Wallace A. Sawdon as executive secretary of the Chapter to succeed John Rife who had resigned because of the press of other business.

The speaker of the evening, W. H. Farrand, discussed the foreign production program of P. A. D. In reviewing the production situation world wide, he pointed out that "many areas are now devoting practically 100 percent of their activity to maintaining their current production rates. Some such areas are Trinidad, Peru, Argentina, and, for practical purposes, Colombia, although the latter country shows a slight increase in 1951. In the Far East, Indonesia showed little increase in 1951, but British Borneo increased about 20,000 b/d. The areas showing the greatest increases are: Canada, which increased about 100,000 b/d; Venezuela, which increased about 200,000 b/d; and the Middle East, which increased 159,000 b/d despite the shutting in of Iran.

"From this quick review, it is apparent that there are not many areas which may be expected to contribute increases for the 1952 program. However, we have calculated that the Western Hemisphere could increase 138,000 b/d if the drilling program were carried out. About 20,000 b/d would come from Canada, 106,000 b/d from Venezuela, 10,000 b/d from Colombia and a couple of thousand barrels from the rest of the Western Hemisphere.

"In the Eastern Hemisphere, exclusive of Iran, we estimate that Iraq would increase 80,000 b/d, Indonesia 20,000 b/d, the Middle East as a whole 167,000 b/d, and North Africa and other areas approximately 3,000 b/d. We thus calculated that the Eastern Hemisphere would step up its production 270,000 b/d.

"As regards the drilling, Canada would drill on the order of 2,000 wells; Venezuela 1,424 wells; Mexico 482 wells; Peru 275 wells; Argentina 246 wells; and the rest of the hemisphere 464, totalling 4,891 wells for North and South America, exclusive of the U. S. It is calculated that the Middle East would drill 153 wells; India and Pakistan 52 wells; the Far East 274 wells; Europe 67 wells; and the other countries 6 wells. This makes a total for the Eastern Hemisphere of 552 wells, The total of 5,443 wells compares with 4,352 wells drilling in the same areas in 1951, an increase of 1,091 wells or 25 percent."

Appointed District Manager

Charles Warthen has recently been appointed Fort Worth district sales manager for Atlas Engineering Works, representing Beaumont Iron Works drilling and producing equipment for the West Texas area. Mr. Warthen has been with Atlas and Beaumont for more than 30 years.

MILLENNIUM-KEY

PETROLEUM FITTINGS

MILLENNIUM KEY

Cast Steel Fittings for oil refinery and chemical plants are manufactured throughout at Braintree by Lake & Elliot Ltd. Close metallurgical control is maintained by competent chemists working with modern apparatus. The independent inspection department can carry out inspection, or work in conjunction with customers own inspectors.

Lake & Elliot Ltd.
BRAINTREE ENGLAND

WEIR

The foremost name in

BOILER FEED PUMPS

and

POWER PLANT AUXILIARIES

for more than sixty years

FEED PUMPS
FEED HEATERS
DE-AERATORS
EVAPORATING & DISTILLING PLANTS
REGENERATIVE CONDENSERS
and
HEAT EXCHANGERS

G. & J. WEIR LTD.
CATHCART · GLASGOW

ADVERTISER'S INDEX

(Advertising Agencies in Italics)

Aerofin Corporation 4
Richards & Webb, Inc.

American Cyanamid Company 59
Hazard Advertising Company

A. E. Ames & Co. Ltd. 116
MacLaren Advertising Co. Ltd.

Anglo-Canadian Oil Company Ltd. 145
J. J. Gibbons Ltd.

Anglo-Iranian Oil Company 139
S. H. Benson Ltd.

Arabian American Oil Co., Inc. 50

Badger Process Division, Stone & Webster, Inc. 6
Thames Advertising Service Ltd.
Harold Cabot & Co., Inc.

William M. Barret, Inc. 133
Bozell & Jacobs (La.) Inc.

Bethlehem Steel Company 7
Gotham Advertising Company, Inc.

Bongard & Company 142

Born Engineering Company 127
Watts, Payne Advertising, Inc.

S. R. Bowen Company 170
Dozier, Eastman & Co.

British Ropes Ltd. 141
D. J. Keymer & Co. Ltd.

Peter Brotherhood Ltd. 137
Rooster Publicity Ltd.

Brown & Root, Inc. 57
Laughlin-Wilson-Baxter & Persons, Inc.

Burton, Delingpole & Co. Ltd. 51
S. H. Wright & Co. Ltd.

The Butterley Co. Ltd. 39
Rowlinson-Broughton

California Texas Oil Company, Inc. 52
Cunningham & Walsh, Inc.

Calvan Consolidated Oil & Gas Co. Ltd. 164
James Lovick & Co. Ltd.

Canadian Atlantic Oil Co. Ltd. 144
James Lovick & Co. Ltd.

Canadian Bank of Commerce 26
Albert Frank-Guenther Law, Inc.

Canadian Oil Companies Ltd. 9
Crombie Advertising Co. Ltd.

Canadian Western Natural Gas Co. Ltd. 149
J. J. Gibbons Ltd.

Carbometals Ltd. 14
Rooster Publicity Ltd.

Carlile & McCarthy 144
James Lovick & Co. Ltd.

Caswell Cranes & Erection Ltd. 53

Catalytic Construction Co. 60
Benjamin Eshleman Company

Central Leduc Oils Ltd. 150
James Lovick & Co. Ltd.

Chicago Bridge & Iron Company 1
Russell T. Gray, Inc.

Cooper-Bessemer Corporation 21
The Griswold-Eshleman Company

Crossley Premier Engines 169
Osborne-Peacock Co. Ltd.

Dominion Bank 119
Albert Frank-Guenther Law, Inc.

Dominion Securities Corporation Ltd. 167
Cockfield, Brown & Company Ltd.

Dresser Industries, Inc. 58
Laughlin-Wilson-Baxter & Persons, Inc.

Dunlop Rubber Co. Ltd. 40, 149

E. I. du Pont de Nemours & Co. 17-18
Charles L. Rumrill & Co.

Ethyl Corporation 3
Batten, Barton, Durstine & Osborn

Excelsior Refineries Ltd. 164
Stewart, Bowman, MacPherson Ltd.

Failing Supply Co. 160

Federated Petroleums Ltd. 117
James Lovick & Co. Ltd.

Flexible Drives (Gilman's) Ltd. 162
Boswell & Barratt, Ltd.

The Fluor Corporation Ltd. 43
Dozier, Eastman & Company

Foster-Wheeler Corporation 129, 161
Albert Frank-Guenther Law, Inc.

Gairdner & Company Ltd. 151
Thornton Purkis Agency

General Petroleums of Canada Ltd. 167
James Lovick & Co. Ltd.

Geophysical Service, Inc. 163
Auld Advertising

Government of the Province of Alberta 13
Stewart-Bowman-MacPherson Ltd.

Graver Tank & Manufacturing Co., Inc. 2
Simmonds & Simmonds, Inc.

Halliburton Oil Well Cementing Co. 16, 62, 174
Bachrodt, Newell, O'Kane & Gano, Inc.
Hill & Christopher Advertising

G. A. Harvey & Co. (London) Ltd. 55

Home Oil Company, Ltd. 143
J. J. Gibbons Ltd.

Hurst-Nelson & Co. Ltd. 137
Osborne-Peacock Co. Ltd.

Imperial Bank of Canada 118
McKim Advertising Ltd.

International General Electric Co. 112
Grant Advertising, Inc.

International Harvester Co., Inc. 22
McCann-Erickson Corporation

International Paints Ltd. 169
Mayfair Advertising Ltd.

International Petroleum Exposition 28-29
Gibbons Advertising Agency, Inc.

M. W. Kellogg Company 32-33
Gordon Baird Associates, Inc.

N. V. Ketjen 10

Keystone Development Company 173
Brennan Advertising Agency

Koch Engineering Company, Inc. 25
The Lago & Whitehead Company

John Laing & Son Ltd. 131

Lake & Elliot 171
Ripley, Preston & Co. Ltd.

R. P. Leveque Investments Ltd. 145
J. J. Gibbons Ltd.

Link & Nauss Ltd. 144

London & Midland Steel Scaffolding Co. 47
S. H. Wright & Co. Ltd.

The Lummus Company 136
Harris D. McKinney Organization

Arthur McKee & Co. 31
Meermans, Inc.

McLeod, Young, Weir & Company Ltd. 117
Thornton Purkis Agency

Magnet Cove Barium Corporation Cover III
Rives, Dyke & Company

Fred Mannix & Company Ltd. 11
James Lovick & Co. Ltd.

Metaducts Ltd. 165
Rooster Publicity, Ltd.

Metal Containers 35
Murray-Watson Advertising Service

National Airoil Burner Co. 167
R. E. Lovekin Corporation

National Petroleum Corporation Ltd. 115

Nesbitt, Thomson & Co. Ltd. 143
Crombie Advertising Co. Ltd.

A. P. Newall & Co. Ltd. 125
Osborne-Peacock Co. Ltd.

New Superior Oils of Canada Ltd. 167
James Lovick & Co. Ltd.

Nicerol, Limited 27
Townsend-Smith Ltd.

C. O. Nickle Publications 164

Oil Center Tool Company 157
Rives, Dyke & Company

Orbit Valve Company 159
Watts, Payne Advertising, Inc.

Samuel Osborn & Co. Ltd. 152

Otis Pressure Control, Inc. 54
Dan Goodrich Advertising

Pacific Petroleums Ltd. 164
James Lovick & Co. Ltd.

Palmer Publications 56

Petroleos Mexicanos 168

Petroleum Rectifying Company 156
John C. Fellows Company

Petty Geophysical Engineering Company 20
Wallace Davis & Company

Procon, Incorporated 154-155
Simmonds & Simmonds, Inc.

Pyrene & Company Ltd. 38
Nelson Advertising Service Ltd.

Reed Roller Bit Company 153
Brennan Advertising Agency

Refinery Engineering Company 135
Watts, Payne Advertising, Inc.

Rice Hotel 166
Ritchie Advertising Agency

James Richardson & Sons 145
Thornton Purkis Agency

Ross, Knowles & Company 150
Thornton Purkis Agency

Royal Bank of Canada 166
Albert Frank-Guenther Law, Inc.

Royalite Oil Co. Ltd. 128
James Lovick & Co. Ltd.

Schlumberger Well Surveying Corp. 111
Rives, Dyke & Company

Security Engineering Co., Inc. 41
The McCarty Company

Seismograph Service Corporation 37
Watts, Payne Advertising, Inc.

Shell Oil Company, Inc. 12
J. Walter Thompson Company

Shell Oil Company of Canada Ltd. 42
J. Walter Thompson Company

Sydney Smith & Sons Ltd. 49
S. H. Wright & Co. Ltd.

Socony-Vacuum Oil Company 30
Compton Advertising, Inc.

Southern Geophysical Company 46
Cowan-Gilliam Advertising Company

Spirax Manufacturing Co. Ltd. 141

Standard Oil Company (N. J.) 15
McCann-Erickson Corporation

Standard Vacuum Oil Company 23
Sam J. Gallay Advertising

Stewarts & Lloyds Ltd. 36
H. Raymond Morgan

Stone & Webster, Inc. 34
Doremus & Company

Stothert & Pitt Ltd. 162

The Texas Company 24
Cunningham & Walsh, Inc.

John I. Thornycroft & Co. Ltd. 134

Tide Water Associated Oil Co. 19
Lennen & Mitchell, Inc.

Toronto Iron Works Ltd. 147
James Fisher Co. Ltd.

Trans Empire Oils Ltd. 142
James Lovick & Co. Ltd.

United Geophysical Company 158
Dozier, Eastman & Company

Universal Oil Products Company 44-45
Simmonds & Simmonds, Inc.

Warren Petroleum Corporation Cover II
Gibbons Advertising Agency

G. & J. Weir 171
Scottish Industrial Advertising

Williams Brothers Corporation 151
Watts, Payne Advertising, Inc.

Willys-Overland Export Corporation 8
Ewell & Thurber Associates

George Wimpey & Sons 165

Wood, Gundy & Company Ltd. 115
Thornton Purkis Agency

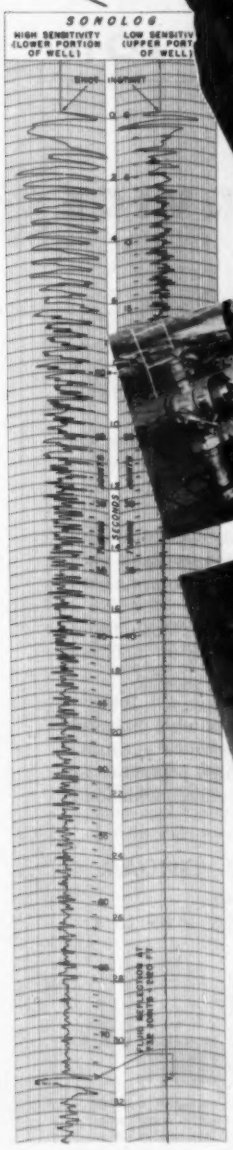
Worthington Pump & Machinery Corporation 48
James Thomas Chirurg Company

Wyatt Metal & Boiler Works Cover IV
Wallace Davis & Company

Youngstown Sheet & Tube Company 5
The Griswold-Eshleman Co.

THE KEYSTONE NEW IMPROVED SONOLOG ACOUSTIC WELL SOUNDER

U. S. Patent 2,560,911



A PRECISION INSTRUMENT FOR MEASURING THE FLUID LEVEL IN PRODUCING WELLS BY THE ACOUSTIC METHOD

... for the purpose of determining bottom pressure
... to obtain productivity index

... for analysis of operational difficulties such as defective pump or tubing.

SONOLOG provides two entirely separate recording channels operating simultaneously at different sensitivities and with different characteristics.... a feature that greatly aids in securing reliable data.

SONOLOG

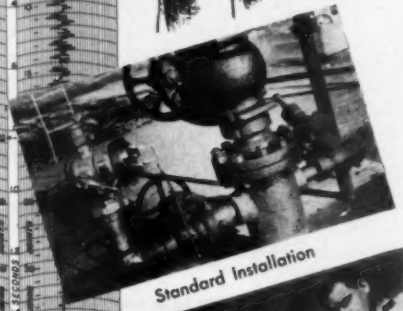
... is a rugged instrument
... is simple to operate and maintain
... attaches to well head with quick-thread 2" union
... uses a blank cartridge as source of sound

SONOLOG IS EASY TO USE

... Observations are made without suspending producing operations or pulling rods or tubing.

SONOLOG IS FAST

... Recordings may be obtained on twenty or more individual wells per 8-hour working day.



Standard Installation

High Pressure Installation

RENTAL PRICES

First month	$300.00
Second month	250.00
Third month	200.00
Thereafter, per month	150.00

By prior arrangement, a portion of all rentals paid or due may be applied against the purchase of complete equipment.

Typical log obtained from one shot and accompanying echoes down well. Two sensitivities permit amplification of impulses as they become dampened farther down well, enabling fluid level to be accurately determined.

SPECIFICATIONS

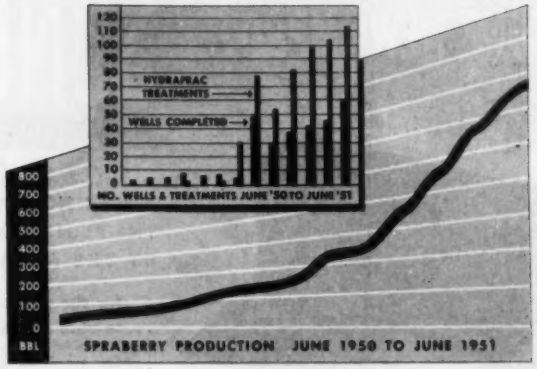
FORM: Strictly portable. Sturdy construction. May be carried by one person or in any conveyance. WEIGHT: Amplifier-Recorder . . . 70 pounds, Well Head Attachment . . . 30 pounds. POWER: Automobile or any 6-volt battery. RECORDING: Instantaneous ink-on-paper. Eliminates camera, film and developing process. Log available for immediate inspection. PRESSURE RATING: Pressure rating of Well Attachment 1500 psi. (A Well Attachment rated at 5000 psi is available at extra cost.) OPERATOR: One man only. No knowledge of electronics required for operation. DELIVERY: Immediate.

PURCHASE PRICE

Complete Equipment, including well head attachment, amplifier-recorder, microphone cable, power cable, 2" male union, cartridge rings, orifices, wrenches, record counter and supply of recording paper, ink, blank cartridges, microphones, cleaning brushes, and operating manual.

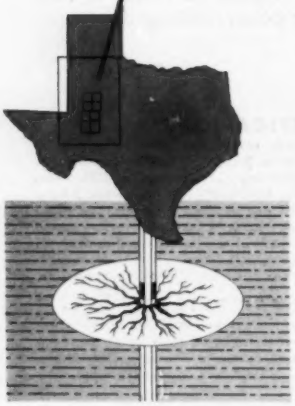
Terms: Net F.O.B., Houston, Texas $3600.00

KEYSTONE
DEVELOPMENT CORPORATION
2811 Westheimer Road • Houston, Texas


HYDRAFRAC TREATMENTS
WELLS COMPLETED
NO. WELLS & TREATMENTS JUNE '50 TO JUNE '51
BBL
SPRABERRY PRODUCTION JUNE 1950 TO JUNE 1951

90% INCREASE PRODUCTION

by HALLIBURTON'S HYDRAFRAC SERVICE



An excellent example of how Hydrafrac treatment increases oil flow is shown in reports from Spraberry wells. 90% of those treated by Halliburton's Hydrafrac Service have been highly successful. Most of these were new wells on which initial production tests indicated less than 40 barrels per day. After Hydrafrac Treatment – average daily potential 10 to 15 barrels per hour flowing.

Hydrafrac treatments increase existing permeability and create *new* permeability by hydraulically fracturing the formation. Sands can be fractured at various intervals throughout the producing zone, with no subsequent cleanout required.

Basically, Hydrafrac Service comprises use of a viscous hydrocarbon gel carrying graded sand particles capable of holding the fractures open, chemicals which follow to reduce the gel viscosity, and packers and pumping equipment for producing the fracturing pressures.

More and more operators are using the process as a completion means. It's more economical and convenient while the rig is over the hole and postpones the time when additional well stimulation is required.

Before you pass up *any* possible pay, in new wells or old, find out first if Halliburton's Hydrafrac Service can make it a profitable producer.

Phone your nearest Halliburton representative – he will assist in the selection of wells for Hydrafrac Service which have high possibility for success. Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

YEARS AHEAD IN PRODUCTION IMPROVEMENT TECHNIQUES!

Mined and processed by people who know and "live" mud, Magcogel Bentonite adds just the "right touch" to your drilling mud because . . . it is completely dispersed and quickly hydrated so that its effect on wall building and gel properties is present as soon as the mud enters the hole. Magcogel makes a low-per-barrel-cost mud because so little is needed. It has all the desirable properties of a good drilling fluid except weight.

Magcogel Bentonite is made from carefully selected high gel type colloidal Wyoming bentonite, carefully mined and processed under rigid laboratory control at the newest and most modern bentonite mill in the world.

Look for the Magcobar sign when you need mud. More than 350 Magcobar Dealers are ready with adequate stocks of Magcogel Bentonite to enable you . . . night or day . . . to add just the right touch to your drilling mud.

MAGNET COVE BARIUM CORPORATION

ONE OF THE DRESSER INDUSTRIES

MALVERN ARKANSAS • HOUSTON, TEXAS

The new Magcobar bentonite mill and mine at Greybull, Wyoming, will add more than a million tons of carefully selected, high gel type, colloidal Wyoming bentonite reserves, for use by the oil industry.

ONE OF THE BEST THINGS THAT EVER HAPPENED TO THE OIL INDUSTRY

Magcobar

Complete

DRILLING MUD SERVICE

DEALER

Magcobar • Magcogel • High Yield • Magco-Fiber • Xact Clay • Fiber Seal • Leather-Floc • Form-A-Plug • Cell-O-Seal Salt Gel • Magco-Phos • Red Ox • Magco-Mica • Tannathin Jel-Oil Mud • Jel-Oil "E" • "E" Concentrate • Noheev My-Lo-Jel Preservative • Quebracho • Chemicals

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